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Editor's Reference Book on Cement and Concrete

1926 EDITION

To the Editor:

This booklet is a reference work. Your business, automobile, financial and building page writers will find it exceptionally valuable. Nowhere else can you obtain such a handy compilation of the authoritative statistics presented herein.

Whenever there is a news story to be written regarding a concrete road, a concrete bridge, or a concrete public building, this booklet will be of great aid in providing supplementary facts.

Whenever editorials must be prepared regarding road and street paving policies or other public improvements, you will find most illuminating data that will assist you to comment accurately and interestingly.

Ready reference tables on road mileages, highway maintenance costs, cement production and use, as well as many other facts of value to newspapers, are printed here.

Save the booklet. You will find it valuable.

Portland Cement Association

A National Organization to Improve and Extend the Uses of Concrete

33 West Grand Avenue
CHICAGO

OFFICES IN 31 CITIES

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(Printed in U. S. A.)

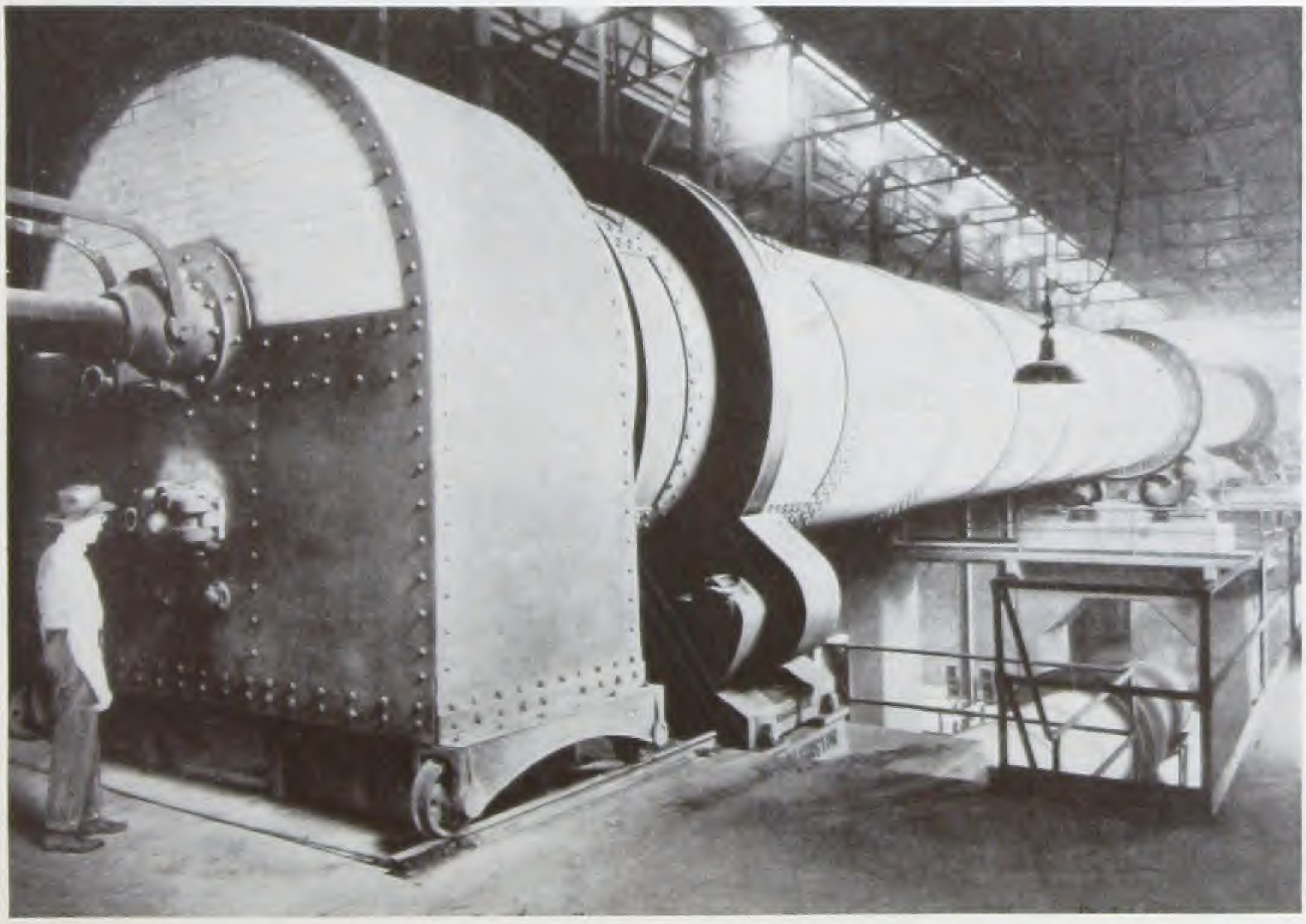
Kilns Hotter Than Volcanoes

EVERY now and then some one comes forth with an announcement that such and such a belief is a myth—for example, naturalists proclaim that the ostrich does not bury its head in the sand when frightened. Another common belief which investigation discredits is that the volcano is the hottest thing on earth. It isn't. In the cement kiln of every day industry, heats are attained much hotter than that of the molten lava hissing in the depths of craters.

The temperature of the volcano Kilauea, Hawaii, said to be the only volcano of which the temperature has been measured, varies from 1,652 to 2,192 degrees Fahrenheit. The temperature of a modern rotary cement kiln averages from 2,500 to 3,000 degrees Fahrenheit—a heat some 800 degrees higher than that of the volcano.

Yet the volcano has been of untold benefit to mankind in a way that few realize, for it was volcanic ash thrown on the earth's surface by the volcano Vesuvius that enabled the early Romans to make a good cement more than two thousand years ago.

But even in the tremendous heat of the cement kiln the pulverized raw materials remain unmelted. Instead, the fine powder forms into little balls, called clinker, which are later ground into portland cement. So cement, composed of various accurately proportioned ingredients and burned at such a high temperature is a material that offers full protection against building fires, which ordinarily do not reach the temperature of a volcano.



Looking into a cement kiln, the largest piece of moving machinery in all industry, is like looking at the sun.

Good Sources for News

NEWSPAPERS interested in construction facts will find the various branch offices of the Portland Cement Association, and particularly the fieldmen who work under the direction of these offices, excellent sources of information regarding improvements in their territory. If you are not in a city where a branch office is located, you can easily learn from the nearest one how to get in touch with the fieldman in your locality. You will find him well posted on building projects, and thoroughly alive to what may be expected in the near future.

During the last few years, many newspapers have found information about house design and construction of such interest to their readers that not a few have promoted the construction of "model homes." To publications interested in setting before their readers the latest developments in home design—particularly small homes—the Portland Cement Association offers an excellent service free. Along with this is available information about farm improvements, which has shown itself to be an interesting feature for publications with rural circulation.

Many publications have attracted thousands of dollars' worth of building material and farm equipment advertising to their pages by featuring news of interest to prospective home owners and farmers, using as a nucleus the mat services offered by the Association. These are set forth in detail elsewhere.

Following are the district offices, and the men in charge:

Atlanta, Ga., Hurt Bldg., J. M. Marshall, Jr., Dist. Engineer.
Birmingham, Ala., Age-Herald Bldg., W. C. Ross, Dist. Engineer.
Boston, Mass., 10 High St., L. T. C. Loring, Dist. Engineer.
Chicago, Ill., 33 W. Grand Ave., L. S. Trainor, Dist. Engineer.
Columbus, Ohio, 16 E. Broad St., R. L. Brown, Dist. Engineer.
Dallas, Tex., Athletic Club Bldg., C. A. Clark, Dist. Engineer.
Denver, Colo., Ideal Bldg., P. F. Meade, Dist. Engineer.
Des Moines, Iowa, Hubbell Bldg., W. H. Steiner, Dist. Engineer.
Detroit, Mich., Dime Bank Bldg., O. O. Stone, Dist. Engineer.
Indianapolis, Ind., Merchants Bank Bldg., L. C. Miller, Dist. Engineer.
Jacksonville, Fla., Graham Bldg., W. R. Macatee, Dist. Engineer.
Kansas City, Mo., Gloyd Bldg., R. M. Simrall, Dist. Engineer.
Lincoln, Neb., 321 Terminal Bldg., D. D. Price, Dist. Engineer.
Los Angeles, Calif., 548 S. Spring St., Amos H. Potts, Dist. Engineer.
Milwaukee, Wis., 1st Wis. Natl. Bank Bldg., L. S. Brodd, Dist. Engr.
Minneapolis, Minn., Metropolitan Bk. Bldg., F. S. Altman, Dist. Engr.
Nashville, Tenn., Cotton States Bldg., F. M. Whitfield, Dist. Engineer.
New Orleans, La., Hibernia Bank Bldg., W. D. Steward, Dist. Engineer.
New York, N. Y., 347 Madison Ave., B. H. Wait, Manager Eastern Offices.
Oklahoma City, Okla., First Natl. Bank Bldg., B. E. Clark, Dist. Engineer.
Parkersburg, W. Va., Union Trust Bldg., J. H. Riddle, Dist. Engineer.
Philadelphia, Pa., 1315 Walnut Street, L. N. Whitcraft, Dist. Engineer.
Pittsburgh, Pa., Jenkins Arcade Bldg., R. S. Taggart, Dist. Engineer.
Portland, Oreg., Gasco Bldg., C. B. Nims, Dist. Engineer.
Richmond, Va., 904 E. Main St., J. E. Tate, Dist. Engineer.
Salt Lake City, Utah, McCornick Bldg., F. H. Richardson, Dist. Engineer.
San Francisco, Calif., 785 Market St., A. P. Denton, Dist. Engineer.
Seattle, Wash., Seaboard Bldg., H. M. Hadley, Dist. Engineer.
St. Louis, Mo., Syndicate Trust Bldg., H. E. Frech, Dist. Engineer.
Vancouver, B. C., Birks Bldg., A. E. Foreman, Dist. Engineer.
Washington, D. C., Union Trust Bldg., G. A. Ricker, Dist. Engineer.

Early Romans Experimented with Concrete

TWO thousand years ago the Roman builders were not only extensive users of cement but also were interested in obtaining better concrete through experimentation.

In viewing the foundations of the Forum structures as they stand today, the observer finds proof that the early craftsmen were not in accord as regarded the use of coarse aggregate, the broken stones they mixed with cement, sand and water to form concrete. In the effort to secure a better concrete some Roman builders laid the concrete in layers, alternate layers being made with different stones. Others preferred to mix the different kinds of rocks together and the concrete was dumped in the forms in one mass without distinction as to layers. This is the method used by builders of the present day.

Yet with their unscientifically manufactured cement, made from volcanic ash and lime obtained from burnt marble, and their haphazard mixing methods, the ancient Romans built concrete foundations which appear to be as sturdy today as they were during the life-time of Julius Caesar.

The question is frequently asked: "Why did not the Romans utilize cement in building high structures?" The answer is simple. The Romans had no knowledge of reinforcing concrete and consequently cement was chiefly used in foundations and as mortar.

Ancient Concrete Still Good

But they did understand unreinforced concrete, for an examination of the foundations of the Forum buildings shows that the concrete is still without a crack or a fracture. The markings from the grain of the wood forms are as plainly visible as though the imprint was made yesterday rather than over 2,000 years ago.

Famous old world structures in which concrete was used are the Pantheon, Coliseum, Temple of Romulus, Palace of Augustus, Temple of Julius, and Arch of Titus.

Vesuvius Helped Romans

The Romans made their cement by mixing slaked lime with ashes deposited by Vesuvius and other less famous volcanoes. So without the aid of the laboratories of the present day the Romans made cement which served their purpose well, even though their product was not at all uniform. The cement of the Romans also had the desirable characteristic of modern cement in that it would harden under water—a quality highly essential to modern building.

Even the grain of the wood used as forms is still discernible although this concrete was made by the Romans more than twenty centuries ago.

Yet after all there is a wide gulf

The concrete foundation of the Temple of Julius, completed 29 B. C., is still as sturdy as when first built.

between the cement of early Rome and the product which is used so extensively today. After the fall of the Roman empire cement making, along with a good many other arts, disappeared for a time and was not revived until the middle of the eighteenth century. But after its rediscovery the changes in manufacturing methods came about rapidly until the present highly scientific cement was developed.

Aspdin Invents Portland Cement

A cement which would harden under water was created by John Smeaton in 1756. This hydraulic cement was used by Smeaton in building the first satisfactory foundation for the Edystone lighthouse off the coast of England. Smeaton's product was improved at various times by later experimenters but it was not until 1824 that portland cement was invented. Joseph Aspdin, a stone mason of Leeds, England, discovered that a better cement could be made by powdering, burning and grinding the materials proportioned by himself rather than by using the ready-made materials provided by nature.

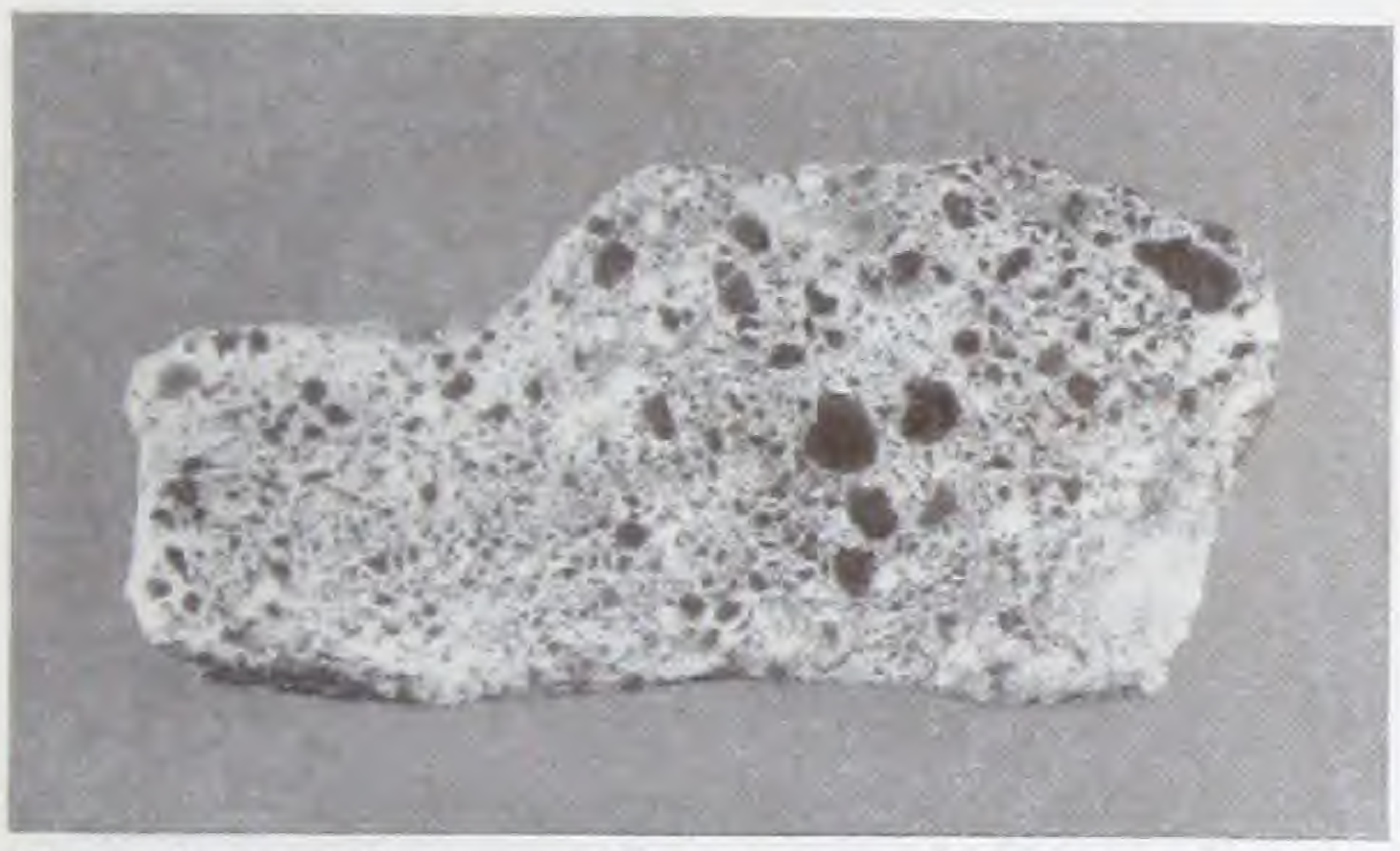
Aspdin called his product "portland cement" because of its resemblance, when made into concrete, to stone from the Isle of Portland, a building stone used in such structures as Westminster Abbey.

But even Aspdin's product was unscientific. His cement was developed through guess work rather than through exact laboratory calculations. However, he discovered the principle which was later taken advantage of by manufacturers, who developed modern portland cement. Although portland cement had its origin in Europe, the United States is the cement capital of the world. The 92 manufacturers of portland cement in this country make more of this product than all the rest of the world combined.

Modern Concrete Stronger Than Early Roman Product

CONCRETE placed in rough wooden forms by the Romans two thousand years ago in foundations served its purpose well. However, recent comparative tests have shown that modern concrete is from four to seven times stronger than the concrete of the ancients.

Concrete from the castle of St. Angelo, Rome, tested at Lewis Institute, Chicago, showed a compressive strength of 900 pounds per square inch. That is, a pressure of 900 pounds to the square inch was required in order to break up cubes of it. At the same time concrete was tested from Wacker Drive, Chicago, a double decked driveway now under construction. This concrete when only 28 days old withstood a pressure of 4,000 pounds per square inch. Since concrete grows stronger with age, it will doubtless attain much greater strength eventually.



Two-thousand year old concrete from the foundation of the Castle of St. Angelo, Rome, which withstood a pressure of 900 pounds per square inch.

The high quality of the modern product is further illustrated by the strength of concrete taken from the 27-year old bulkhead wall in the Delaware River. The average compressive strength for exposed concrete was 5,780 pounds per square inch while concrete from below the tide level showed an average strength of 6,280 pounds.

The much higher strength of modern concrete is attributed to better cement and to the better mixing and handling methods evolved through scientific study.

"Portland Cement" Not a Trade Name

ALTHOUGH Irish potatoes are known throughout the world as a type of potato, many people still have the mistaken belief that portland cement is the name of one particular brand of cement manufactured by a single company. On the contrary, portland cement is the name of a kind of cement which distinguishes it from rubber cement, natural cement or other cementing materials, and which is manufactured by different companies in practically all important countries.

In the United States alone there are 141 portland cement plants located in 29 states. Each manufacturer designates his product with his own trade name in addition to the name "portland cement" or "cement."

When the portland cement industry was in its infancy some forty years ago, each manufacturer made portland cement according to his own idea or those of his customers. Good and indifferent portland cements appeared on the market then much the same as good and indifferent vegetables or diamonds are placed on the market today. In 1898 a compilation was made of 91 different specifications for portland cement.

Specifications Standardized

This situation does not exist today. Cooperation between the American Society for Testing Materials, the U. S. Bureau of Standards and others brought about uniform requirements. After exacting experiments and study, a single set of specifications was established in the United States in 1921. All portland cement in this country is now manufactured in accordance with these specifications and the builder is assured material meeting them, regardless of the name of the manufacturer which appears on the sack above the words "portland cement."

The Story of Cement in America

ALTHOUGH cement had its origin and early development in Europe, the United States is the portland cement capital of the world. This country, with a yearly production large enough to provide every man, woman and child here with a barrel and a third of cement, manufactures and uses more of this product than the rest of the world combined.

Until the first portland cement was made in this country in 1872 by David O. Saylor, in the now famous Lehigh Valley district of Pennsylvania, all portland cement was imported from Europe. But even after Saylor demonstrated that just as good cement could be made in the United States as in Europe, builders continued to use the foreign product in comparatively great quantities.

First Cement Not Scientific

Saylor, a maker of natural cement, began his experiments in portland cement manufacture by carrying buckets of rocks which he burned in his kitchen. John K. Shinn, another Pennsylvanian, also saw the possibilities of manufacturing portland cement so he likewise created a portland cement by means of make-shift machinery. Thomas Millen decided that $9.12 was too much to pay for the imported portland cement which he converted into concrete pipe. After preliminary experimenting Millen manufactured the first portland cement in Indiana, in 1876.

Foreign portland cement and domestic natural cement were long great competitors of the American made portlands. So great was this competition, in fact, that many companies fell by the wayside. Finally the superior American product gained a strong foothold and now every part of the country has its own adequate supply of this building material. However, it was not until 1897 that the use of American cement exceeded the importations from Europe.

So well has the superiority of the American product been demonstrated that at present the imports are only about two per cent of the domestic production.

Production Greater Than Demand

With a total capital investment of about $500,000,000, 141 portland cement plants are now in operation in this country with an annual capacity at least one-fourth greater than the record year's demand. These plants are now capable of manufacturing approximately 200,000,000 barrels of cement a year. In 1925 some 161,000,000 barrels were made with the nation's builders actually using 5,000,000 barrels less, or 156,000,000 barrels.

Portland cement is now made in 29 states, the largest producers being Pennsylvania, Indiana, California, Michigan, Missouri, New York, and Illinois. The map on the inside back cover shows the location of all plants.

How Portland Cement Is Made

ALTHOUGH a material that builds great dams, bridges, skyscrapers and other structures requiring tremendous strength, portland cement is made up of the tiniest particles, finer than flour or talcum powder. More than eighty operations are necessary in manufacturing this highly scientific cement, a product which is as carefully prepared and tested as most foodstuffs.

In kilns that are hotter than volcanos, the powdered raw materials are burned until glass-hard balls the size of marbles are formed. These balls, called clinker, then pass through grinding mills that reduce them to flour. This pulverized material is now portland cement, a powder so fine that at least 78 per cent of it will pass through a bronze sieve having 40,000 holes to the square inch.

Portland cement is manufactured from various combinations of rocks such as limestone and clay or shale, cement rock and limestone, limestone and blast furnace slag, and marl and clay. The essential ingredients in these rocks, lime, silica and alumina, are accurately proportioned and only after numerous careful tests.

From Boulders to Powder

In quarrying, the first step in the manufacture of portland cement, it is not uncommon for 100,000 tons of stone to be torn loose with a single charge of high explosives. From the quarry the raw materials are carried to the giant crushers which easily break rocks as large as hogsheads into fragments. These fragments then pass through secondary crushers which crush the material into still smaller pieces. At this point the various raw materials are usually combined and the mass goes

A portland cement plant as it looks from the clouds. The structures of a single plant contain machinery weighing thousands of tons.

through a group of mills where it is converted into a gray powder.

Kilns 250 Feet Long

Following this, the powder is placed in the upper end of the huge fire-brick lined kilns, horizontal steel tubes, 125 to 250 feet long, which resemble factory chimneys. As the kiln revolves the raw material gradually comes in contact with a jet of flame from 30 to 40 feet in length blown into the discharge end of the kiln. This mammoth blow torch is fed with powdered coal, oil, or gas. The resultant heat of from 2,500 to 3,000 degrees Fahrenheit—enough to melt steel—brings the cement material nearly to the melting point. Here the chemical and physical changes take place which give the product its cementing qualities.

The raw material in the form of cement clinker then passes to the cooler. The clinker may then be ground into cement or may be stored until needed. Before the final grinding gypsum is added in order to control the rate of setting or hardening when the cement is used in making concrete.

Fill Sacks Through Bottoms

From the pulverizers the cement goes to the storage bins to await sacking. Here again time saving methods and machinery have been adopted. Even the sacks are tied before filling. The sacks are filled through the bottom by means of a flap valve which closes when the sack is placed right side up. For the convenience of the user each sack contains 94 pounds of cement, or one cubic foot.

There is a touch of mystery about the modern cement plant since so much of the hard labor is performed by time and labor saving machinery. From the moment the material is dumped into the crusher until it is sacked, the product is as untouched by hands as the bread of the modern bakery. Belt conveyors and screw conveyors, the powerful rock crushers, the gigantic kilns, the massive pulverizers, all reduce the number of workmen. Only through the development of such labor and time saving machinery could cement be economically produced.

One-Third of Raw Materials Lost

Of these modern machines used in portland cement making the kiln is without doubt the most interesting. In this fiery furnace one-third, and oftentimes more, of the raw material passes off as a useless gas. A modern rotary kiln will burn a ton of coal every fifteen minutes, an average of 100 to 165 pounds of coal per barrel of cement produced. The cement kiln is the largest piece of revolving machinery used in any industry.

Another machine of great importance in cement manufacture is the tube mill in which the clinker is pulverized. This mill contains a charge of steel balls which may weigh as much as a steel freight car. As the tube mill rotates the steel balls fall back upon the clinker, pulverizing it so finely that it is soft to the touch.

Power requirements of the cement industry afford a good indication of the complex nature of its manufacturing operations. In power installed, the cement industry ranks tenth among all manufacturing industries.

Each portland cement plant has chemical and physical laboratories. Tests are run frequently throughout the entire process of manufacture. Before shipment, a complete set of tests is made on the finished product in order to further assure the builder that the cement meets the strength requirements. Portland cement is sold to meet the specifications of the American Society for Testing Materials. Only manufacturing companies meeting these specifications are eligible to membership in the Portland Cement Association, the educational and promotional organization of the industry.

USE OF PORTLAND CEMENT PER CAPITA

(Computed from U. S. Bureau of Mines Reports for 1925)

State	Use of Portland Cement per Capita (in barrels)	Rank in Use per Capita	Per Cent Total Shipments Used by Each State	Rank in Total Used
Alabama	0.86	31	1.35	21
Arizona	1.03	27	0.27	39
Arkansas	0.43	46	0.50	34
California	3.06	2	7.86	4
Colorado	1.13	22	0.73	30
Connecticut	1.14	21	1.12	23
Delaware	1.72	7	0.26	40
District of Columbia	1.86	6	0.59	32
Florida	3.24	1	2.61	11
Georgia	0.46	45	0.90	28
Idaho	0.52	41	0.16	44
Illinois	2.06	4	9.17	3
Indiana	1.62	10	3.17	9
Iowa	1.07	24	1.71	16
Kansas	1.23	20	1.43	19
Kentucky	0.72	35	1.14	22
Louisiana	0.58	40	0.70	31
Maine	0.43	47	0.21	43
Maryland	1.39	16	1.37	20
Massachusetts	0.82	32	2.16	14
Michigan	2.32	3	6.12	5
Minnesota	1.35	17	2.20	13
Mississippi	0.32	49	0.37	36
Missouri	1.61	11	3.56	8
Montana	0.37	48	0.15	45
Nebraska	1.23	19	1.07	24
Nevada	1.31	18	0.06	49
New Hampshire	0.94	29	0.27	38
New Jersey	2.01	5	4.50	7
New Mexico	0.47	44	0.12	48
New York	1.64	9	11.70	1
North Carolina	1.09	23	1.93	15
North Dakota	0.49	42	0.22	42
Ohio	1.48	14	5.97	6
Oklahoma	1.06	25	1.52	18
Oregon	1.56	13	0.84	29
Pennsylvania	1.59	12	9.45	2
Rhode Island	1.04	26	0.45	35
South Carolina	0.48	43	0.55	33
South Dakota	0.69	36	0.30	37
Tennessee	0.67	37	1.04	26
Texas	0.82	33	2.67	10
Utah	0.77	34	0.24	41
Vermont	0.61	39	0.14	47
Virginia	0.67	38	1.05	25
Washington	1.67	8	1.57	17
West Virginia	0.94	30	0.96	27
Wisconsin	1.43	15	2.55	12
Wyoming	1.01	28	0.14	46

United States Leads In Cement Making

THE portland cement mills of the United States produced 161,202,000 barrels, or 644,808,000 sacks of cement during 1925, according to reports issued by the United States Bureau of Mines. This is more than the production of all the rest of the world combined.

The extensive development of the portland cement industry in the United States is best illustrated by the capacity of the 141 plants now in operation. The yearly capacity of these plants is estimated to be 200,000,000 barrels, or 27 per cent more than the greatest year's demand. In other words, American mills can produce one-fourth more cement than they have ever shipped to users in a year.

One of the chief reasons for the cement leadership attained by the United States is the wide distribution of cement making materials. Every populous section of the country is now within a short hauling distance of a cement plant.

If the electricity required in supplying the power needed in making cement were to be paid for at average household rates, this one cost of power per barrel would alone amount to more than the price now charged for cement at the mill. So the development of time and labor saving machinery has made it possible to supply this highly manufactured material for about half-a-cent a pound.

The same demand for speed and efficiency which has placed the United States at the top as an industrial nation has likewise affected to a great degree the volume of building with cement. No other building material is used in as many ways as cement.

PRODUCTION, SHIPMENTS AND STOCKS OF PORTLAND CEMENT IN THE U. S.

(Statistics from U. S. Geological Survey and U. S. Bureau of Mines)

Year	Production (Barrels)	Shipments (Barrels)	Stock on Hand at End of Year (Barrels)
1870-1879	82,000	....	....
1890	335,500	....	....
1895	990,324	....	....
1900	8,482,020	....	....
1905	35,246,812	....	....
1910	76,549,951	....	....
1911	78,528,637	75,547,829	10,385,789
1912	82,438,096	85,012,556	7,811,329
1913	92,097,131	88,689,377	11,220,328
1914	88,230,170	86,437,956	12,773,463
1915	85,914,907	86,891,681	11,462,523
1916	91,521,198	94,552,296	8,360,552
1917	92,814,202	90,703,474	10,353,838
1918	71,081,663	70,915,508	10,451,044
1919	80,777,935	85,612,899	5,256,900
1920	100,023,245	96,311,719	8,833,067
1921	98,842,049	95,507,147	12,192,567
1922	114,789,984	117,701,216	9,267,238
1923	137,460,238	135,912,118	10,900,370
1924	149,358,000	146,048,000	14,123,000
1925*	161,202,000	156,724,000	18,429,000

*Figures for 1925 are preliminary and subject to revision.

The Portland Cement Association

In order to better carry on the research and promotional duties of the cement industry, the Portland Cement Association built its own concrete home in Chicago, shown here just before it received the finishing touches.

THE recently completed home of the Portland Cement Association, Chicago, is a reinforced concrete structure built strictly in accordance with the scientific methods developed in the research laboratory maintained by the Association. Construction was carried on throughout the winter.

This new building, five stories in height, is faced with cut concrete stone. In the interior, use is made of concrete art marble and plastered areas illustrating various decorative possibilities of portland cement.

The new building serves as a yard stick in measuring the progress of the Portland Cement Association, which was organized 24 years ago. From the first small gathering has developed the present nation-wide association with its three-fold purpose—to educate, to promote, and to investigate.

The Portland Cement Association is one of the few trade or service associations which has found it necessary and economical to "own its own home." From the first single paid secretary the Association has grown until it now has 470 employees, of whom about 320 are experienced engineers. The Research Laboratory, with a staff of 40, has been operated in cooperation with Lewis Institute, Chicago, but it is now housed in the new building, with the 120 employees of the general office.

Cement has hundreds of uses. It is therefore the gigantic task of the Port-

land Cement Association to lead in standardizing methods in using cement, to advise the user in regard to the best methods, to make thorough research in devising new and better methods and to promote the use of concrete where it is adaptable.

To facilitate this work the myriad duties are divided among the various bureaus of the association where trained men give the latest information on the use of cement, whether it be for a stucco house, a concrete incinerator, a pavement or a swimming pool.

Has 31 District Offices

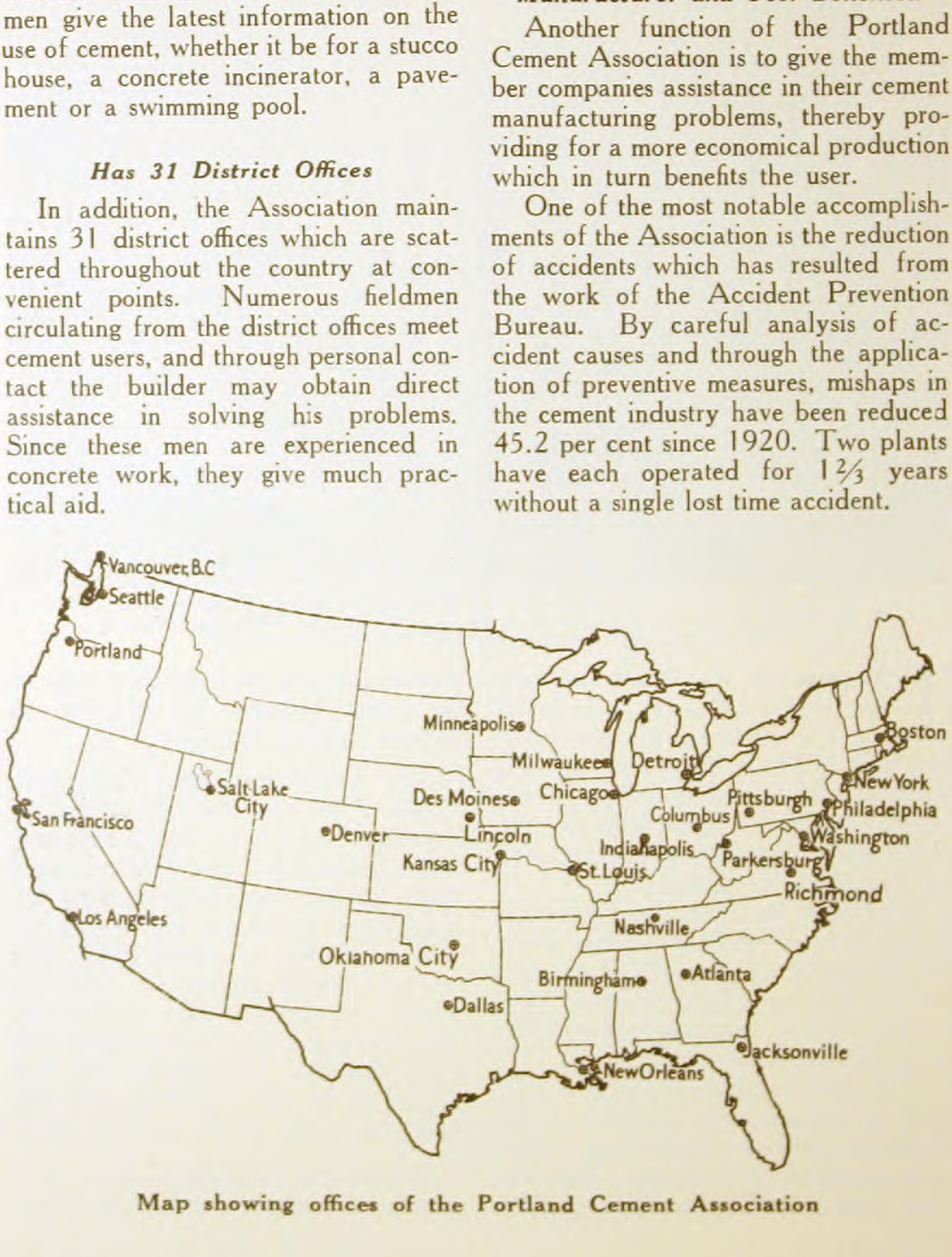
In addition, the Association maintains 31 district offices which are scattered throughout the country at convenient points. Numerous fieldmen circulating from the district offices meet cement users, and through personal contact the builder may obtain direct assistance in solving his problems. Since these men are experienced in concrete work, they give much practical aid.

The field representatives frequently call on contractors, public officials, engineers, architects and civic organizations. By means of this intercourse much of the direct promotional work is accomplished. Through this close contact the district offices have also been responsible for higher quality concrete in pavements and structures.

Manufacturer and User Benefited

Another function of the Portland Cement Association is to give the member companies assistance in their cement manufacturing problems, thereby providing for a more economical production which in turn benefits the user.

One of the most notable accomplishments of the Association is the reduction of accidents which has resulted from the work of the Accident Prevention Bureau. By careful analysis of accident causes and through the application of preventive measures, mishaps in the cement industry have been reduced 45.2 per cent since 1920. Two plants have each operated for 1⅔ years without a single lost time accident.



Map showing offices of the Portland Cement Association

Association Has Own Laboratory

THE use of a pint too much mixing water in making a batch of concrete is equivalent in weakening effect to leaving out two pounds of cement. This is one of the many important facts discovered at the laboratory of the Portland Cement Association.

Since portland cement is such an easy material to use and since for that reason it is very often misused, the Portland Cement Association cooperated with Lewis Institute, Chicago, in founding the Structural Materials Research Laboratory. Here definite methods of concrete making have been evolved and even the small user may obtain first class concrete by following the comparatively simple suggestions advocated by the laboratory.

Make Thousands of Tests

Every little detail that may have a bearing on concrete making is thoroughly investigated at the laboratory and no conclusions are presented to the public until each theory has been proved. More than 45,000 tests were made in 1925 by the staff of forty. The results of these investigations are made known through newspapers, bulletins, magazine articles, lectures and through the work of the district offices and fieldmen of the association.

This Research Laboratory, under the leadership of Professor Duff A. Abrams, is the only laboratory in the country devoted exclusively to the study of cement and concrete. It was organized in 1916 at Lewis Institute where concrete research had been in progress for two years. It now has quarters at the Association's new home.

The most important spread of knowledge has been accomplished through the Association's field force which comes in close contact with builders, engineers and contractors. In this way building in the United States has been immeasurably benefited.

The information is given out to the public without charge. The true benefit of this work lies in the increased use of cement which has come about through the greater popularity of concrete in building, a condition due largely to improved methods.

This testing machine at the Research Laboratory of the Portland Cement Association is capable of applying a pressure of 100 tons. The concrete cylinder shown under test withstood more than 55 tons pressure.

A Mile of Highway Free

Some of the studies made at the laboratory are: The effect of size and grading of aggregate, the changes in quality of concrete resulting from variations in the amount of cement used, and the effect of different foreign materials in concrete. The discovery that too much mixing water weakens concrete has had far reaching effect in producing a higher quality product.

The practical application of the laboratory findings is demonstrated by their use in building a western concrete

highway. On this particular job the highway engineers had been discarding about one-third of the stone aggregate because of its small size. An association fieldman, through the aid of laboratory experiments, found that excellent concrete could be made by mixing this waste aggregate with larger stones. The saving on this job was $30,000, enough to build an additional mile of concrete highway.

Laboratories conducted by most industries are not for the direct benefit of the user but are for the purpose of discovering trade secrets which are either patented or used exclusively by a single firm. On the other hand, the Association's Research Laboratory is conducted for the benefit of both the manufacturer and the user, the findings being disseminated to all who are interested. The small user is especially benefited by such a policy.

How Portland Cement Is Used

(Reprinted from "Concrete" for May, 1926)

RECENT estimates indicate that the portland cement shipments of 156,724,000 barrels in 1925 were used in approximately the percentages shown in the table below. While it is impossible to gather the necessary data on which to base highly accurate estimates, these figures will serve to indicate the relative importance of the various fields of use.

The high rate of operations in the building industry is reflected in the quantity of cement assigned to "Public and Commercial buildings," which classification includes hotels and apartment buildings. The great popularity of concrete roads and streets is seen in the total estimated use in that field, which also makes allowance for cement required in the concrete bases of other types of paving.

Miscellaneous small town and farm uses account for a surprisingly large percentage of the total. This and the two preceding classifications, all of which represent small sales, represent nearly a third of the total shipments.

Uses	Per Cent
Public and Commercial buildings	26.0
Houses (exclusive of rural)	8.5
Sidewalks and private driveways (exclusive of rural)	5.5
Small town and farm uses	18.0
Concrete pipe for water, sewers, irrigation and culverts	4.5
Paving and highways	27.5
Railways	5.5
Bridges, river and harbor work, dams and water power projects, storage tanks and reservoirs	3.0
Miscellaneous uses	1.5
	100.0

While the more spectacular concrete structures, such as huge dams and great bridges, individually call for considerable quantities of cement, their number is so small comparatively that they constitute a much less important factor in the total demand for cement than the more commonplace classes of work.

The average tire wear in traveling over 1,000 miles of bitulithic pavement is 1.07 pounds of rubber and on 1,000 miles of concrete 0.609 pounds are worn away, according to recent tests conducted by Washington State College. Tests show that the cost of a tire comes to about $10 a pound for the rubber worn away by the time the tire must be discarded. At this rate the tire cost for each 1,000 miles on concrete would be $6.09 and on bitulithic $10.70.

Cement Industry Conducts Schools

TEACHING the consumer to economize in the use of cement may be said to be the educational policy of the manufacturers of portland cement.

The educational and promotional organization of the industry, the Portland Cement Association, conducts short courses in various cities in the effort to acquaint builders, engineers, architects and others, with the latest information on making concrete. This, of course, means that the required strength may be obtained more economically than formerly, since stronger concrete results from applying the latest knowledge in making it as well as from the use of cement. The use of proper methods saves the builder money.

In so far as possible, these short courses in "design and control of concrete mixtures" are conducted in cities and districts demanding them. These schools usually cover a period of two weeks with eight meetings of three hours each. The effectiveness of this work is illustrated by a recent course in Pittsburgh where 497 trained men completed the outlined work.

Some centuries ago, it took a hundred or even two hundred years for a new mechanical device or a new method to become popular throughout the civilized world.

By means of the concrete short course, those interested in construction have at their disposal knowledge that has only recently been discovered in the Association or governmental laboratories.

Hurries Up Use of New Methods

For instance, the water-ratio method which was developed only a short time ago, is now the common property of engineers. The up-to-date builder no longer mixes his concrete in a haphazard fashion. He knows just how great a strain his concrete must stand. So by using the water-ratio method, he is able to make concrete of the strength desired for any particular project.

Application of this principle involves nothing more complicated than accurate control of the amount of mixing water, since the strength of the concrete is dependent upon the quantity of water in the mix in proportion to the

Hundreds of men interested in design and construction attend the short courses conducted by the Portland Cement Association throughout the country.

amount of cement. Even a pint too much of mixing water will weaken the concrete as much as though two or three pounds of cement had been removed from the batch. Accordingly, scientists have worked out specifications whereby the required concrete strength may be quite accurately obtained simply by controlling the amount of water.

So through the teaching of the water-ratio method and of the proper use of aggregate in these "concrete schools" the Portland Cement Association has been able to secure better and wider use of concrete.

Cement Makers Reduce Accidents

THE greatest reduction in accidents known to any industry has been accomplished by the portland cement manufacturers through mechanical safety appliances and by educating the workmen to believe that "the best safety device is the careful man."

In 1925, accidents to cement workers decreased 32 per cent from the 1924 rate. In 1924 the reduction from 1923 was 18 per cent. Great progress has been made in lessening both the number of accidents and the time lost by workmen on account of accidents.

Reduce Accidents by Two-Thirds

The special no accident campaign conducted in June, 1925, gave a reduction in mishaps by two-thirds, as compared with the number of accidents in June, 1924. The time lost through accidents was lessened by 65 per cent. According to the committee in charge of this work for the Association, the June drive really continued throughout the year, resulting in a big reduction for 1925.

Another no accident month campaign will be conducted in 1926, with emphasis again being laid on the man rather than on safety devices, which after all are largely dependent upon the workman's judgment. This campaign will be carried on through safety lectures, display of safety bulletins, distribution of buttons, and charts posted daily showing progress made in avoiding accidents.

Go Year Without Mishap

Most cement manufacturers carry on a similar although less intensive campaign throughout the year. In 1925, for instance, two plants operated the entire year without a single time lost accident.

Since 90 per cent or so of all portland cement manufacturers belong to the Portland Cement Association, the promotional and research organization of the industry, the accident prevention work for the industry has been carried on effectively through a special bureau and an accident prevention committee. The bureau of accident prevention is in charge of a manager who collects and distributes data from all member companies. Consequently any member company may make early use of the experiences of other members. In addition many worth while suggestions are made by the committee and accident bureau manager.

Since portland cement is used in more types of structures than any other building material and since it is used so extensively, it is now generally regarded as an excellent construction barometer.

Cement is used by the builder probably within two weeks of the time it leaves the mills, on the average. Consequently, cement manufacturers must fill their huge storage bins during the slack winter months in order to meet the spring and summer demands promptly. Cement shipments indicate the activity of the building field.

Forecast Strength of Concrete

"HOW does concrete harden?" is in itself a simple question. But most people in answering this query would declare that concrete hardens through drying. Likewise when the question is asked as to how paint forms a protective coating the answer will nearly always be that paint hardens as it drys.

However, both paint and concrete become of material value, not through drying, but through chemical actions which take place within the paint or the concrete itself.

This fallacy in regard to the setting or hardening of concrete has led many to believe that the amount of mixing water used in making concrete is unimportant. In reality the amount of mixing water controls the strength of the concrete, in fact, so much so that scientists have recently worked out specifications whereby the strength of the material may be pre-determined simply by regulating the amount of water as compared to the quantity of cement.

Too Much Water Weakens Concrete

Consequently when water is haphazardly poured into the concrete mix along with the portland cement, and fine and coarse aggregate, good concrete will be largely a matter of chance. Imagine a cook carelessly dumping dipperfuls of water into his bread batch! Yet this is comparable to the way some people make concrete.

The pre-determination of concrete strengths through the use of varying amounts of water is known as the water-ratio method. Professor Duff A. Abrams of the Portland Cement Association Research Laboratory supervised hundreds of thousands of tests before final specifications were issued. These of course require that the aggregates be sound and durable and that the mix be plastic and workable. Otherwise the strength of the concrete is determined by the proportion of mixing water to cement.

Water Ratio Coming Into Use

Among others, these noteworthy structures were built with the water-ratio method: the Big Four Railway bridge near Sidney, Ohio; the Uiversity of Pittsburgh stadium; and the anchorages of the Camden-Philadelphia bridge. The Portland Cement Association on May 1 this year moved into its own home in Chicago, a structure built in accordance with similar specifications.

Concrete investigators have shown that under the water-ratio plan, uniform strength is assured, regardless of changes of workability or in the sizes of the aggregates. In other words the strength of the concrete is definitely known and a uniform concrete strength throughout a single structure may be obtained.

For ordinary work, the proper amount of water to use in making concrete is the smallest quantity which will give a mix of good workability. Builders in general should use as "dry" a mix as practicable.

Mixing Time Important

Another important point in the making of concrete is the thorough mixing of the materials. Concrete should be allowed to remain in the mixer for at least a minute. Most state highway commissions require at least a minute and a half for mixing. The speed of mixing is not so important as the time of mixing, for the materials must be thoroughly blended to form a good concrete.

Dusty or dirty sand or gravel or crushed stone aggregates will not make a strong concrete. The sand and pebbles must often be washed as well as screened to get rid of clay and or-

ganic material. Organic impurities are especially harmful, as they rob the cement of much of its strength.

Although concrete should be mixed and placed in the forms as dry as possible, it requires frequent moistening to cure it properly. In highway building, for instance, a new concrete road is flooded with water for 10 to 14 days, or is kept moist by a covering of damp earth or straw.

Yet, after all, good concrete making is as easy, and surely as desirable, as good bread making.

Is It a Cement or a Concrete Walk?

WHAT is the difference between a cement walk and a concrete walk? Although a cement walk and a concrete walk are the same thing, many people still find this a vexing question oftentimes asked by a youthful member of the family.

Cement, a short term for "portland cement," is a highly manufactured powder, which when mixed with water, sand, and stone or pebbles, will form a mass rivaling rock in texture, strength and durability. In fact, this mass, commonly called concrete, is so strong that when forcibly broken the pieces of stone will be split open, instead of the cement's relaxing its hold on them.

Portland cement was so named by Joseph Aspdin, its inventor, who noted its resemblance to stone from the Isle of Portland, England, which was used in such structures as Westminster Abbey. So by no stretch of the imagination may the name "portland cement" be attributed to Portland, Me., or Portland, Oreg., although some cement is manufactured near the latter city.

"Portland" Not a Trade Name

The appellation "portland" is applied to this particular cement to distinguish it from natural cement—a cement made from materials already mixed by nature in proportions which are rarely exact. The production of natural cement is now only about one per cent of that of portland cement, which was originally developed by the early manufacturers of natural cement.

Portland cement is manufactured all over the world by many different companies, each of which uses its own trade name in conjunction with the name of the product, "portland cement." In the United States portland cement is manufactured in accordance with specifications established by the American Society of Testing Materials and the United States Bureau of Standards.

Portland cement is composed of a number of ingredients which are chemically united through heating at a temperature approaching 3,000 degrees Fahrenheit. Cement must be ground finer than flour since 78 per cent of it must pass through a sieve of 40,000 holes per square inch in order to comply with the government specifications.

So a cement walk is a concrete walk. Although both terms are much used, "concrete" is to be preferred.

A concrete boulevard 75 feet wide and seven miles long is being contructed by Los Angeles in order to accommodate the ever increasing motor vehicle traffic. Pico Boulevard is to be fitted with an eight inch concrete pavement. The latest types of sanitary sewers, storm drains, and ornamental lights will make this street one of the most modern in the world.

Supplies Needed by the Portland Cement Industry in a Year

MORE than a third of the weight of the raw materials used in portland cement making is driven off in the form of gases by the high kiln temperature. Consequently more than 600 pounds of raw materials are needed to manufacture a barrel of cement weighing 376 pounds. In addition some 200 pounds of coal, or equivalent fuel, is needed to turn out a single barrel.

The estimates given below of materials required by the portland cement industry of the United States in 1925 are based upon preliminary reports of production and shipments issued by the United States Bureau of Mines.

Fuel

The various portland cement plants throughout the country burned 11,500,000 tons of coal during the 1925 manufacturing season. Of this amount 8,000,000 tons were pulverized for burning in the cement kilns. The cement industry is the largest user of powdered coal.

More than 5,500,000,000 cubic feet of gas were also consumed in cement mill operations last year, while fuel oil to the extent of 5,400,000 barrels was required.

Sacks

To replace the cloth sacks lost or destroyed last year would require a strip of cloth 30 inches wide and long enough to reach from San Francisco to New York City just seventeen times. Most of the 250,000,000 sacks in use are of cotton although some are of jute.

The use of paper bags for cement shipping increased last year with a total of 77,000,000. In making these bags, about 33,000,000 pounds of paper were required.

About 58,000 miles of wire were needed for tying the cloth sacks filled with cement last year.

Lubricants

To keep the gigantic cement manufacturing machinery in good condition, more than 44,000,000 pounds of lubricating oil and grease were used in 1925.

Belting

Because of the heavy demands made in power transmission and in belt conveying, about 417 miles of belting were worn out in cement mill operation.

Power

The cement industry ranks tenth among all industries in the total horse power of the machinery in use. The power installation needed for a single large plant produces enough electricity to supply a city of 100,000 population with power and light.

Explosives

More than 18,000,000 pounds of high explosives were used last year to blast loose the rock containing the several cement making ingredients.

Gypsum

About 800,000 tons of gypsum were ground up with the cement clinker to control the rate of hardening of the cement when made into concrete.

Fire Brick

In lining the cement kilns, which are heated to a temperature of from 2500 to 3000 degrees Fahrenheit, approximately 6,200,000 fire brick were used last year.

Shipping

The portland cement industry is the fourth larger shipper of manufactured goods according to Interstate Commerce Commission figures. The cement produced last year would fill 700,000 freight cars.

Building in Winter

MOST people regard a year as being twelve months in length, but in the building industry the year has been too often shortened to eight months. For during the four winter months a building taboo apparently settles over the country, since new construction is then only a third or fourth of the summer volume.

However, through the wide diffusion of knowledge concerning proper construction in winter, the amount of building during the cold months is slowly but surely increasing. For instance, shipments of portland cement were greater by one-fourth in December of 1925 than in December of 1924. With some allowance for possible differences in weather conditions, this is held to indicate a moderate increase in winter construction. Bradstreet's survey shows that the value of contracts awarded in December 1925, is larger by 8.7 per cent than the value of December 1924 contracts.

Winter Slump a Habit

The winter slump in building is largely a matter of habit. Even in the southern states there is a strong tendency for construction to falter from November to March. Up until a score of years ago building in winter was almost unknown. At that time the builder did not understand how to use concrete successfully in winter, a knowledge that is now necessary for concrete enters into practically all forms of construction. So when methods of accomplishing first class concrete work in cold weather were developed, builders were slow in taking advantage of them because of the winter "let-down" habit which has been so long established.

Simple precautions permit as satisfactory building in winter as in summer. The one problem in the use of concrete is to keep it warm enough so that it will gain specified strength. This has been successfully solved by heating materials and using canvas enclosures and heaters for a few days following the placing of concrete in the forms.

Winter Building Saves Time and Money

The advantages of winter construction are manifold. When building continues through the winter months, the prosperity of the community is kept on an even keel, for the buying power of an unemployed man is greatly decreased. Furthermore, the builder benefits directly through lowered overhead costs. He is able to keep his force of workmen the year round, thus avoiding a costly reorganization in the spring. In addition, the cost of labor is less in winter and labor efficiency is greater. Many builders are of the opinion that the cost of the necessary precautions is thus more than offset. Then, too, the owner profits by saving interest on his investment since the structure comes into productivity earlier. In other words, building in

Through the observance of simple precautions, building with concrete in winter may be as satisfactory as at any other time of the year.

winter saves time and money.

One of the best examples of winter construction is the building of an extremely large paper mill in northern Quebec. Of the 35,000 cubic yards of concrete placed for this mill, over half was deposited in the forms during severe freezing weather when temperatures from 20 to 30 degrees below zero were common occurrences. A thorough examination has revealed that this concrete work is excellent.

The Portland Cement Association's building at Chicago, shown on page 13, is also an interesting example of cold weather construction.

Buying Concrete By Telephone

READY - MIXED, unhardened concrete ordered over the telephone by the user much the same as coal, is a picture of the future painted by building material dealers. In fact, twenty-two cities throughout the United States now have in successful operation permanent central mixing plants where enough concrete for a door step or a city street may be purchased.

This new industry of making and selling concrete, like many infant industries, was founded in the interest of economy. The portable concrete mixing plant must be moved about from job to job, a costly and time losing item, as any builder knows. So by patronizing the permanent central mixing plant the builder not only eliminates this loss but also the burden of maintaining his own plant, including trucks for hauling concrete materials.

Concrete when properly mixed may be hauled for at least eight or ten miles. Consequently the builder finds the permanent central plant economical, because of mass production, so long as the hauling costs of the finished product do not reach too high a figure. In the main, cheaper concrete is provided in large areas surrounding central plants.

Gives a Uniform Product

Another favorable feature of the permanent central mixing plant is that of uniformity and high quality of product. Most small mixing outfits are not equipped with accurate devices for measuring the sand, water, and stone, which are mixed with cement in order to form concrete, and considerable care is needed to get a uniformly high-grade product. Permanent plants with modern equipment and expert management are more readily able to turn out concrete of a definite quality. Since different building projects require different concrete mixtures, the central plant is not only prepared to provide a scientific product, but a uniform product for each particular use as well.

Inasmuch as concrete is an easy material to make it is often abused. A tendency exists to use too much mixing water since "wet" concrete is easier to handle than "dry." Investigation has disclosed that for ordinary use, the drier the concrete mix, the stronger the finished product will be. In order to haul concrete without injuring its quality it must be of a stiff consistency. Consequently it is believed that the increased use of permanent central mixing plants will on the whole tend to create a still higher quality product.

Commercial mixing plants now serve builders in the following cities:

Little Rock, Ark.	Bloomington, Ill.
San Mateo, Calif.	Seattle
Sioux City, Ia.	Los Angeles
Pittsburgh	Santa Ana, Calif.
Birmingham	Houston
Des Moines	Fort Worth
Kankakee, Ill.	New Orleans
Danville, Ill.	Philadelphia
Urbana, Ill.	Youngstown, Ohio
Galesburg, Ill.	Indianapolis
Wood River, Ill.	Wichita Falls, Tex.

Streams Still Get Most of Nation's Sewage

FOUR-FIFTHS of the sewage of all cities in 36 states is dumped raw into the nation's waterways, according to a survey conducted recently by the Portland Cement Association with the cooperation of state sanitary engineers. Sanitation experts point out that this figure probably holds good for the entire United States.

Of the 91,000,000 people living in these 36 states only 16.5 per cent of them are served by municipal sewage treatment plants—plants which convert the vile sewage into an inoffensive sludge, valuable as fertilizer. The same survey indicates that only about half of the population of the 22 states reporting is served by sewerage systems.

Most persons are familiar with sewerage systems and the pipe lines which compose them, but they give little thought to where these pipe lines carry the sewage. As a matter of fact, the poisonous sewage has been dumped for years into streams where it has in many cases destroyed all fish life. These streams are so polluted that they are unfit for either domestic or industrial use.

Sewage Kills Fish

At a hearing conducted recently by the Wisconsin railroad commission a group of men testified that they had removed ten tons of dead fish from the Flambeau River. How stream pollution has affected fish life is further evidenced by fishing in the Illinois River, where the catch of about 21,000,000 pounds in 1908 was reduced to about 7,000,000 pounds in 1920.

Harold T. Pulsifier, editor of "The Outlook," has stated: "Under the genial habit of passing the muck, the magnificent Hudson, once a source of health, pleasure and profit, has lost its right to be called a river and earned the more unpleasant title of The Hudson Sewer."

However, a number of movements have been started within the last few years to educate the public in regard to the unhealthful conditions surrounding improper sewage disposal. A bill was passed at the 1925 session of the Michigan state legislature requiring all incorporated cities to treat their sewage. Good examples of sewage treatment activity are found in Milwaukee, Indianapolis, Baltimore, Houston and Chicago.

Sewage disposal is a vital topic which is as pertinent to general welfare as government control over manufactured foods.

Proper sewage disposal costs little when measured in terms of health.

Use One Million Tons of Concrete Pipe

CONCRETE pipe is now used for sewers and other purposes by practically every city in the United States. The total quantity so used in 1925 would build the equivalent of a 12-inch pipe line from New York to San Francisco and from San Francisco back to Miami.

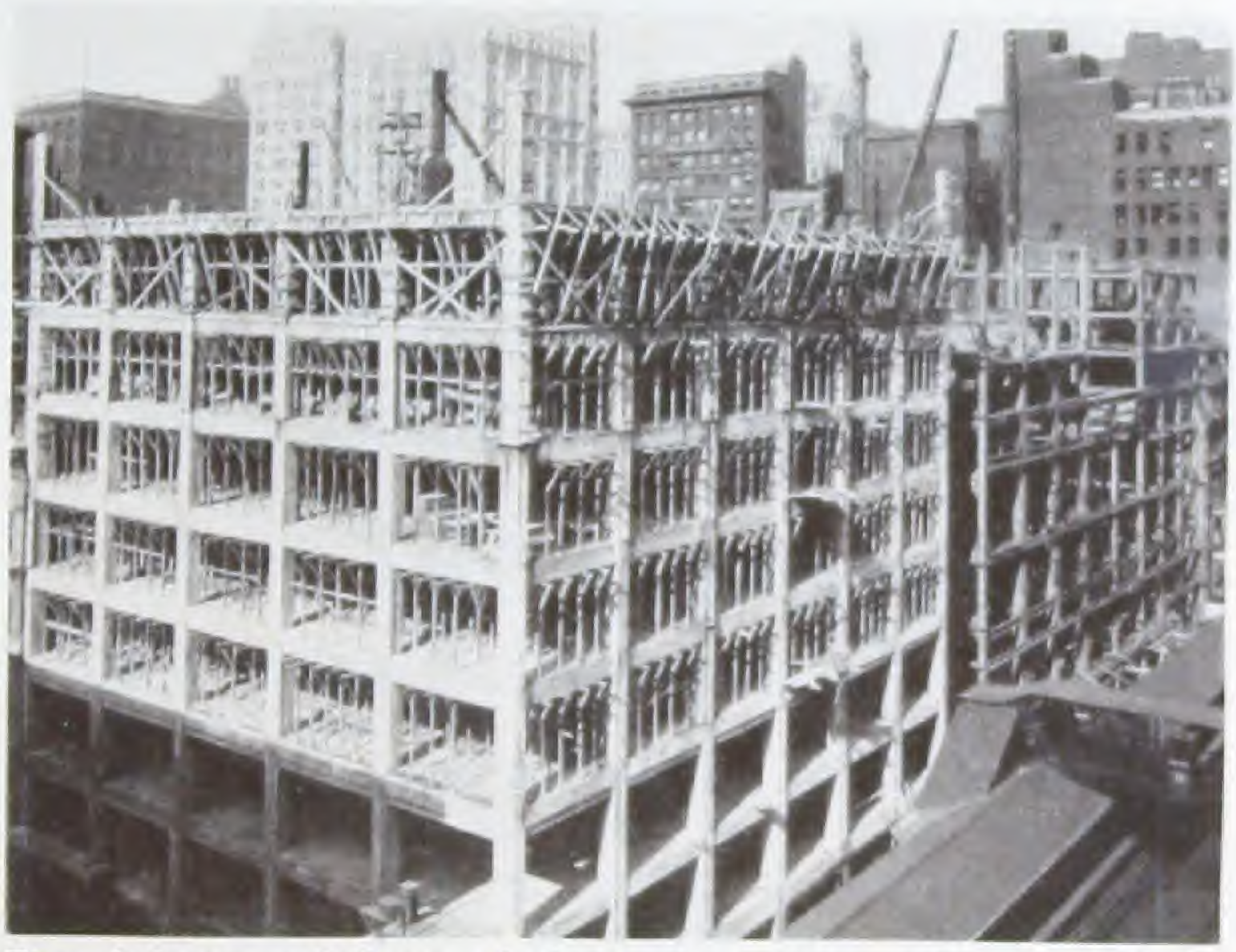
The weight of the concrete used in pipe construction last year probably exceeded 1,000,000 tons. Three-fourths of this concrete was used in the manufacture of sewer pipe.

Among the many cities using concrete pipe in their storm and sanitary sewer systems are Portland, Oreg., Milwaukee, Los Angeles, New Orleans, Newark, Houston, Oklahoma City, Salt Lake City, Ogden, Omaha, New York City, Syracuse, Utica, Schenectady and Atlanta.

Saving Time With Concrete

IN the busy loop district of Chicago the reinforced concrete frame-work and floors of the 12-story Hartman Furniture Company building were erected in 65 working days—more than a story a week. This was done in spite of the thousands of pedestrians and automobiles, and the hundreds of street cars which daily crowd around the Hartman corner.

The building of this structure is typical of the rapid construction now possible through the use of modern concrete building methods developed within the last decade or so. In fact office and industrial buildings, homes, dams, streets, pavements, and other concrete structures may be built twice as fast today as they were 10 or 15 years ago.



The skeleton and floors of the twelve-story reinforced concrete Hartman building, Chicago, were completed in sixty-five working days—more than a story a week.

Time, of course, is one of the most important factors to be considered in construction work. Rapid construction means lessened overhead charges and lowered building costs. Furthermore, the building becomes of value to the owner earlier. Cutting building time means cutting building expenses.

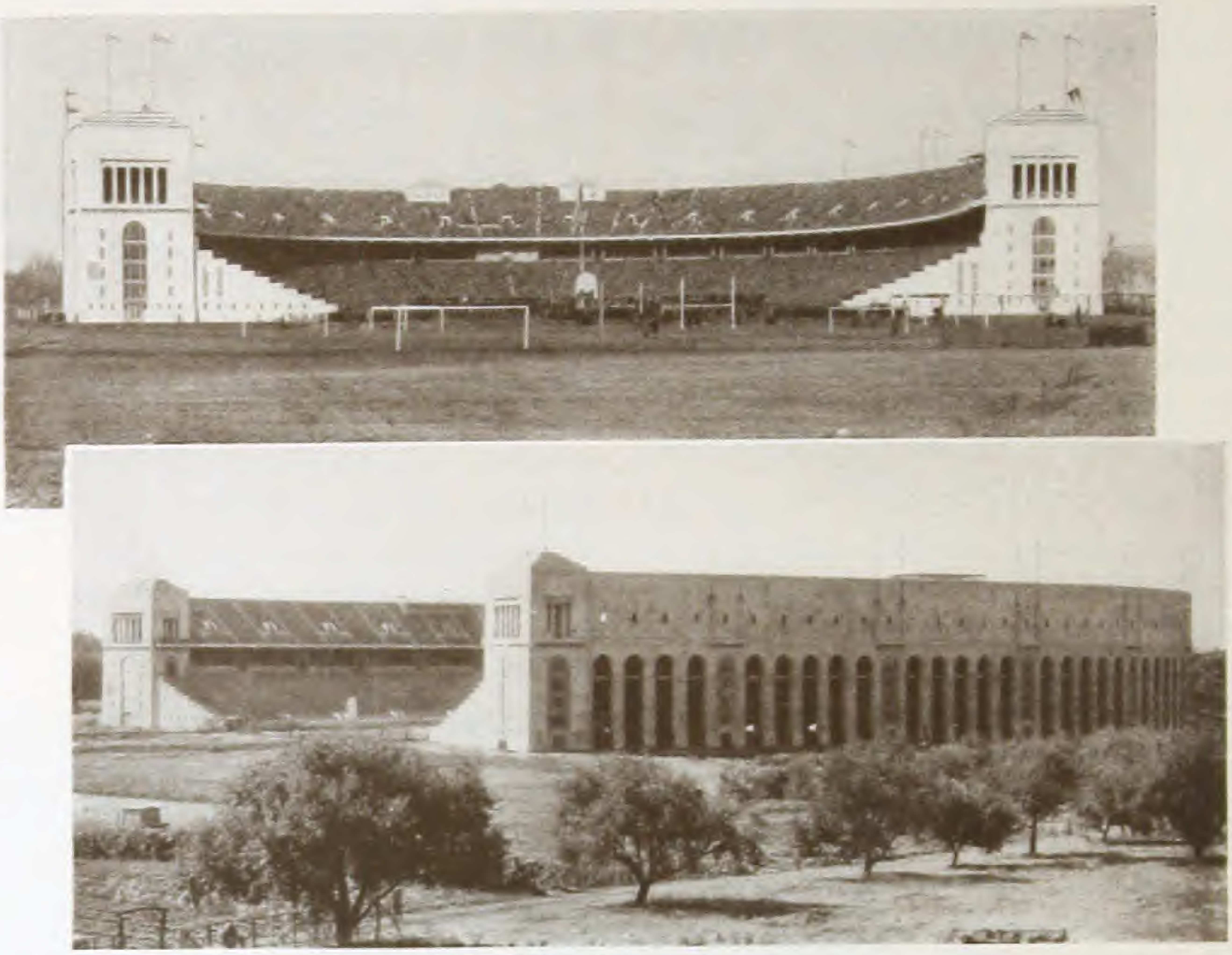
Build Fast With Concrete

Time saving concrete mixing and placing machinery is now common. Mixers that turn out a cubic yard of concrete every two minutes or so are universally used. In large projects concrete is rapidly carried to the forms by elevators and two-wheeled buggies or by chutes. Rapid building may also be accomplished with concrete tile and concrete block. The large size of these masonry units permits quick placing since a greater area is covered and less mortar is required.

Just a few years ago it was unusual for concrete highway contracts to be awarded for more than a mile or so at once. In 1910 it took a month to build a mile of concrete road. Nowadays contracts are often placed for the construction of from 20 to 50 miles and pavement may be built twice as fast—a mile every 15 days.

So in addition to its permanence and beauty, concrete also saves time and money through quicker building.

A concrete sewer pipe line recently uncovered in Newark, N. J., was found to be in excellent condition after 58 years of service. Concrete pipe sewers have been in service in Oshkosh, Wis., since 1855 and in Hudson, N. Y., since 1867.



The 70,000 capacity Ohio State University Stadium at work and at rest. This stadium successfully accommodates 5,200 tons of lively humanity.

Newspapers May Help Cities Get Swimming Pools and Stadia

NEWSPAPER publishers in many cases have done much toward obtaining municipal, college or high school stadia and swimming pools for their cities through the cooperation given the backers in their news columns.

Various cities are still without these recreational facilities, not because the necessary money isn't available, but because no unified or concentrated effort has been made to secure them. The newspaper, of course, is best equipped for arousing public sentiment. In securing a stadium or swimming pool the community is benefited and the good will felt toward the newspaper is appreciably increased.

The concrete Sesqui-Centennial Stadium in Philadelphia, which will be completed soon, will seat approximately 100,000 persons the entire population of Utica, New York. On the other hand, a recently completed stadium of 18,500 capacity adequately serves Drake University at Des Moines.

Some of the concrete stadia in the United States are as follows:

Balboa Park, San Diego
Cornell Crescent
Grandstand, West Palm Beach
University of Washington
University of Nebraska
Terre Haute
Louisiana State University
Erie High School
University of Kentucky
Centennial, Macon, Ga.

Centre College
Franklin Field Stadium, Philadelphia
University of Pittsburgh
Scott High School Stadium, Toledo
University of Iowa
West Side Tennis Club, Forest Hills, N. Y.
West Point
Tacoma High School
University of Washington
Brown University

Some of the Concrete Stadia in the United States—Continued

Los Angeles Coliseum	Purdue University
Rose Bowl, Pasadena	Ohio State University
University of California	University of Minnesota
University of Denver	University of Wisconsin
University of Kansas	Soldiers' Field, Chicago
University of Illinois	Princeton University
Harvard University	Yale Bowl
Vanderbilt University	Cincinnati University

Citizens of Altoona, Pennsylvania, disporting themselves in the world's largest concrete swimming pool.

Trains May Run on Concrete Roadbeds

(News article from Chicago Daily News, December 21, 1925)

A NEW age of transportation, with crack passenger trains running safely at terrific speed on concrete roadbeds, was predicted today by Frank H. Alfred, Detroit, president of the Pere Marquette railway, one of forty-three prominent executives from all sections of the country attending meetings of the American Railway association at the Blackstone Hotel.

Cars of the new trains are to speed on roller bearings. The smooth concrete roadway is to be re-enforced with steel trusses. The trains are to run almost as fast as airplanes.

"To the airplane theory, our answer is 'safety'" said the president of the Pere Marquette. "The new roadbed and bearings will give railroad trains speed comparable to that of the planes. And the superior safety of the rails will continue.

"If it's speed the public wants, we can give it to them. By the new system, we can carry people as fast as they want to go.

"After all, we will just be doing for the rails what others have done already for the highways. When the good roads movement started lots of us thought gravel would be good enough. But the states went farther, and made the very safest and fastest roads possible. That is what I believe we will do with the rails."

Burned Out Astoria Rebuilds

AFTER a single sleepless night, citizens of Astoria, Oregon, viewed 40 acres of smoking timbers and ashes—all that remained of the heart of the oldest American settlement west of the Mississippi.

Today, three years after that December fire, may be seen block after block of new buildings. Of equal importance to this rapid and complete rebuilding is the fact that Astoria's new business section is perhaps as nearly fire-proof as possible.

Before the fire, Astoria had scarcely a fire-resistive building in the downtown section. Records now show that of the ninet or so new structures erected since the co flagration, only one is of combustible co struction. The other structures are reinforced concrete.

Yet modern building was not demande by the Astoria building code, for tl Astoria code, while more strict than tho of many cities, is still far from idea Nevertheless, the business men and hon builders in the burned out area profited b their costly experience and built structur far better than those demanded by tl

ith Buildings That Won't Burn

building code of their city.

Quite unlike the pre-fire days, the streets of Astoria are also fire-proof. Because of Astoria's location on the tide-flats created by the Pacific Ocean's backing up into the mouth of the Columbia river, Astoria has found it necessary to build part of her pavements on piling. Prior to the fire of 1922 these piles were timbers and the pavements were laid on planking. Consequently the draughts created by this form of construction aided the flames in spreading. So in rebuilding, the streets were made as fire-proof as the structures which line them. Concrete piles now support concrete pavements and further protection is given by concrete fire walls.

At the time of the fire the city of Astoria was generally regarded as "broke" because of her huge bonded indebtedness. But today, with her 28 blocks of buildings not only replaced but safe from another such disaster, Astoria bonds are now selling at a higher price than they have brought for 35 years. It is evident, therefore, that Astoria's so-called economy in the past was really not economy at all.

Fire Losses Grow

EVERY time a person blinks his eyes property valued at $100 or more goes up in smoke and flames. Such is the extent of fire losses in the United States.

During the last four years fire losses have increased tremendously with an average yearly loss of more than one-half billion dollars. The total fire loss for the last 47 years is slightly over $12,000,000,000. The average loss per year for this period is therefore less than half of the annual loss from 1922 to 1926.

Two methods are pointed out whereby fire losses may be reduced. The most obvious is the lessening of carelessness. But since carelessness is as inevitable as death or taxes, a more promising method becomes necessary. This is the construction of buildings that will not burn.

Concrete Withstands Great Heats

Buildings are not regarded as fire-safe unless the framework is protected with a covering of concrete or other fireproofing material, or unless the framework is of reinforced concrete. Since concrete is able to withstand extremely high temperatures, ordinary building fires, which usually do not go above 1800 degrees Fahrenheit, do not affect the stability of concrete structures.

Even though the contents of a fireproof structure catch fire, the flames are nearly always confined to the one structure, and often to a single room. Fireproof structures also largely eliminate loss of life since properly constructed concrete beams and girders do not collapse.

The fire situation becomes still more alarming when it is realized that this country's per capita loss is about eleven times that of the average for all European nations. Furthermore, some 17,-000 people are injured each year in the United States by flames and the annual death toll is 15,000.

The estimated fire losses for the last four years are as follows:

1922	$506,541,001
1923	535,372,782
1924	549,062,124
1925	540,000,000
Total	$2,130,976,640

Concrete Masonry Building

THE use of concrete building block and tile is now so widespread that about 600,000,000 were placed in American buildings during the last twelve months.

Although building in general is on the upward trend, the increase in the use of concrete building units indicates in a measure that buildings are being constructed with permanency and fire-safety more in mind than ever before.

Numerous fire tests have been conducted with small structures of concrete block or tile, all tests indicating that concrete masonry is highly fire-resistive. Although a temperature of 1,800 degrees F. was obtained in testing a concrete block house in Los Angeles, the outside surface of the blocks remained cool while the fire raged within for forty minutes. When cold water from the fire hose was played on the inner walls, not a crack appeared.

Winter Building Practical

That construction with concrete units in winter is practical is proved by the experience of numberless northern builders. In the winter of 1924-25 Michigan alone used about 7,000,000

concrete block and tile while Minneapolis builders placed 4,000,000 units. By using concrete masonry for winter construction, much time is saved for the units are large and require less mortar. Simple precautions make winter construction as satisfactory as summer building.

In addition to the 600,000,000 concrete block and tile used last year, about 300,000,000 concrete brick were marketed. Concrete roofing tile and architectural stone also enter widely into construction.

Recent Concrete Structures of Interest

Double Decked Street

ONE of the greatest double deck street projects ever attempted is Wacker Drive, Chicago, which is now nearing completion. Wacker Drive, in which the concrete used will weigh about 243,000 tons, marks a new era in street construction made necessary by the widespread growth of the automobile. Traffic congestion in Chicago will be greatly relieved by the two decks which will provide a total of 14 traffic lanes.

Tall Buildings

The Palacio Salvo, a new 28 story hotel in Montevideo, Uruguay, South America, is the tallest reinforced concrete building in the world. This hotel which rises 381 feet above street level, is seven stories higher than the tallest building of similar construction in the United States, the United Brethren building in Dayton, Ohio. Throughout the United States, however, there are many concrete structures of about 20 stories in height.

Grain Elevator

A concrete elevator which has a capacity of 3,000,000 bushels of grain has been erected by the Baltimore & Ohio railroad at Baltimore. This elevator—probably the largest in the world—consists of 13 rows of seven bins each. Each bin is 16 feet in diameter and 96 feet deep. Two car loads of grain can be stored in each of the spaces between the bins.

Chimney

The highest concrete structure on the American continent is the 409 foot chimney recently erected for the Consolidated Mining and Smelting Company of Canada. From the 21-foot mouth of the chimney pour the zinc smelter gases, which if not carried high into the air would destroy nearby vegetable life. The structure was completed in 170 working days. A similar chimney is now being constructed for the same company.

Canal Replacement

In replacing the locks of the Welland ship canal between Lake Ontario and Lake Erie, 3,381,000 cubic yards of concrete will be used. This is enough concrete to fill up thirty miles of the New York subway. The replacement of the seven locks is more than half completed.

Dam

Of the several concrete dams of notable size built during 1925 the Exchequer Dam of the Merced Irrigation district in California is representative. This arch dam is 330 feet in height and 955 feet in length. In building the structure over 400,000 cubic yards of concrete were used, enough to construct 170 miles of concrete road 18 feet wide and 8 inches thick.

Water Supply Project

One of the largest water supply projects ever built is the Spavinaw project

which supplies Tulsa, Okla., with pure water through the medium of a 53 mile conduit of four and a half and five foot precast concrete pipe; Tiawah tunnel, which is seven feet in diameter and two miles long; and Spavinaw dam. This dam, which is 3,500 feet long and 55 feet high, impounds a lake of 20,000,000,000 gallons.

Bridge

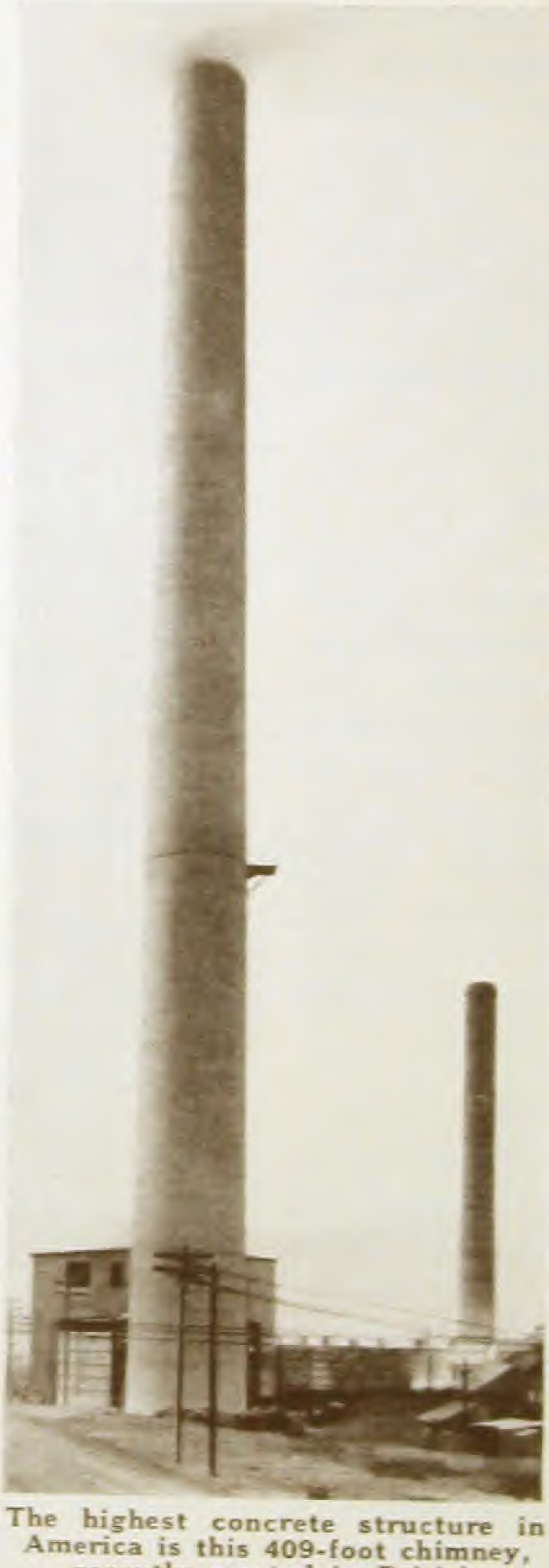
The Clark's Ferry highway bridge over the Susquehanna river near Harrisburg, Penna., is 2,074 feet long exclusive of approaches. This newly completed bridge consists of 15 arches, each with a clear span of 127 feet.

Stadium

Among the noteworthy concrete stadia is the recently completed University of Pittsburgh stadium which has a seating capacity of 70,000 people. This gigantic concrete and steel structure is 791 feet long and 60 feet high. It is planned to add another deck to the stadium which will then be capable of seating 100,000 people. Aside from its colossal size the Pittsburgh stadium is of architectural beauty.

Sewage Plant

The largest activated sludge treatment plant for sewage in the world is now under construction in Chicago. This plant will serve 800,000 people. The sewage will pass through three batteries of aeration tanks, each battery being 420 feet wide and 700 feet long. The structures of this sewage treatment plant will cover nearly 50 acres.



The highest concrete structure in America is this 409-foot chimney, recently erected in British Columbia.

Concrete Track Support

Because of the continuously wet ground in the vicinity of the Chicago Union Station, concrete slabs were placed under all tracks in the train shed, under all approach tracks, and underneath platforms. The total area of these concrete slabs is 25.6 acres, the equivalent of a single track slab 10 feet wide and 21 miles long.

Bridge Piers

Bridge piers 229 feet in height—probably the highest in the world—were recently completed by the Yosemite Valley Railroad to support tracks across the reservoir formed by the Exchequer dam in the San Joaquin Valley, California. These piers are as tall as a 22 story office building.

Wharves

What is said to be the finest wharf in existence is the concrete wharf at the Inter Harbor Navigation Canal at New Orleans. This wharf is 240 feet wide and 2,400 feet long. New Orleans at present is engaged in replacing the old Army Supply Base wharf with a 2,000 foot concrete structure. When New Orleans' program is completed the city will have nearly two miles of wharves, most of which will be concrete.

Concrete piers, higher than a 20-story office building, which will support a Yosemite Valley railroad bridge over a reservoir in California.

Ore Docks

The concrete iron-ore docks at Superior, Wis., constitute one of the most extensive ore handling developments in the world. The first dock of this project was completed in 1911. Since that time various extensions have been made until the docks now have a total length of 4,673 feet. An extension recently completed contains 175 bays, each of which has a capacity of 700 tons of ore.

Wide Highways

Increased motor traffic between Detroit and Pontiac, Mich., a distance of 16 miles, has required the building of an 88-foot concrete pavement. One 44-foot strip has been completed and the remaining parallel strip will be ready for traffic soon. The counties in which Chicago, Detroit and Milwaukee are situated now require that all principal pavements be 40 feet wide, accommodating four lines of vehicles.

Lighting the Street

TURNING night into day is one of the mammoth tasks confronting American cities. In street lighting Chicago has obtained beauty as well as durability in the necessary equipment through the use of concrete lighting standards. This one city alone now has more than 20,000 concrete light poles.

Concrete may be molded into lighting standards of simple or ornate design. In many cases home owners have erected concrete posts in accordance with their own individual tastes. Groups of business men have also installed these distinctive lighting standards in their particular business sections. At Coral Gables, Fla., concrete lamp posts are used by both the city and private home owners since the concrete can be molded to conform with the Spanish style of architecture followed there.

Many Cities Use Concrete Poles

A few of the cities using concrete lighting standards are as follows:

Los Angeles, Calif.	Pittsburgh, Pa.
San Bernardino, Cal.	Beloit, Wis.
Racine, Wis.	Fond du Lac, Wis.
Oshkosh, Wis.	Chicago, Ill.
Aurora, Ill.	Indianapolis, Ind.
Knoxville, Tenn.	Detroit, Mich.
Denver, Colorado	Oklahoma City, Okla.
Rochester, N. Y.	Riverside, Calif.
Milwaukee, Wis.	Urbana, Ill.
St. Louis, Mo.	Newark, O.
Columbus, O.	Bangor, Me.
Dallas, Texas	Richmond, Ind.
Pasadena, Calif.	Maywood, Ill.
Terre Haute, Ind.	Houston, Tex.
Mason City, Iowa	San Francisco, Calif.

Art in Concrete

SINCE concrete can be molded into almost any conceivable form, many builders are finding that art may easily be introduced into structures built of this material.

Through the application of simple architectural principles the builders of the San Francisco Chronicle building have erected a structure of distinguished beauty. Although this reinforced concrete plant is only three stories high with a tower of five stories, its beautiful Scholastic Gothic lines make it as commanding as though it were of twenty stories.

Commercial buildings are usually not regarded as works of art. A glance, however, at the Chronicle's new home reveals that a new art is fast coming into its own. The details of the exterior display legends of press work, the plaques showing old type printing presses, type making, and printers' devils. All of these intricate designs are executed in concrete in the form of precast stone.

Art in Concrete Inexpensive

This one structure illustrates how easy and inexpensive it is to lift a building above the mediocre. Art is as desirable in a building as it is in a painting since the building is exposed daily to the gaze of countless people. For that reason, if for no other, the building should be made attractive as well as suited to its use.

Art in concrete is typified by the San Francisco Chronicle Building, a reinforced concrete structure with stucco finish.

Another type of art in concrete is illustrated by the cloistered walk of the Franciscan Monastery, Washington, D. C. This ambulatory, as it is called, is roughly U-shaped and will consist of 1,000 feet of concrete walk roofed over with reinforced concrete supported by numerous colums grouped in pairs. Each of the nine pairs of columns of each section differs from the preceding pair in form and in color.

For the convenience of the monks in the Franciscan Monastery at Washington, D. C., a cloistered walk 1000 feet long has been artistically built of concrete.

Get Any Desired Color

The varied tints in the columns, walls, ceilings and floors of the ambulatory are obtained by so combining colored stone particles as to get the effects desired. By cleaning the cement particles from the surface these aggregates are exposed and permanent coloring results.

Around the outer edge of the walk steel bars are placed in the concrete so that the ambulatory also serves as a fence. Since the Monks are spending their lives within the monastery grounds no effort has been spared to make this ambulatory attractive. By building with concrete the quality of permanence has also been economically obtained.

In rebuilding Louisiana State University, eleven of the most important new structures were constructed of reinforced concrete finished with portland cement stucco. These concrete buildings, situated on a double quadrangle, compose one of the most pretentious and beautiful groups of college buildings in America.

Stucco Gives Beautiful Effect

By utilizing the texture and color properties of concrete, John J. Earley, architectural sculptor of Washington, D. C., has given an attractive stucco finish to these buildings. In mixing stucco the fine aggregates become coated with the cement particles. In this particular instance Mr. Earley removed these particles from the surface with a steel wire brush, thereby obtaining the desired buff color and roughened texture by exposing the crushed Potomac river aggregates.

When concrete is used in the interior construction, the work is better described by the term "interior architecture" rather than "interior decoration." The same smooth or rugged beauty which marks exterior construction may be utilized in the interior where permanence is also highly desirable.

The Edgewater Beach Hotel, Chicago, Grauman's Metropolitan Theatre, Los Angeles, and the City Club

This stucco finished water tower shows how ordinary structures may easily be beautified.

of St. Louis are representative of the many structures in which concrete has been successfully used in providing suitable interior finishings. In these buildings the natural grace of the concrete is accentuated by permitting form marks to show in varying degrees. Beautiful color effects were obtained through the application of cold water paints directly to the concrete base.

The possibilities of beautiful art work in concrete are well illustrated by the interior of the Edgewater Beach Hotel, Chicago.

Permanent Coloring Now Possible

In building the Church of The Sacred Heart, Washington, D. C., Mr. Earley has gone a step farther in interior architecture. By the use of colored aggregates placed in the intricate designs demanded by a structure of this nature, an interior has been obtained which is just as permanent as the reinforced concrete walls.

Mr. Earley's method of introducing colors cannot be compared with any other process. The effects produced with concrete are similar to those secured with mosaic, yet possessing a softness of effect and color not obtainable in mosaics.

Recently Alfonso Ianelli displayed at the Chicago Art Institute a number of plaster models for memorials which are to be cast in concrete. In commenting on art in concrete Mr. Ianelli has stated, "We have not yet begun to know the artistic possibilities of concrete in this country. The Lorado Taft monument, the Fountain of Time, however, indicates the effects that may be secured."

The Fountain of Time referred to by Mr. Ianelli consists of a hundred figures passing by a heroic figure of Time. A pleasing surface was created by exposing the buff colored aggregate.

Mr. Taft, himself a world famous sculptor, in speaking of concrete molding, has remarked, "It seems to me that we are on the verge of one of the greatest developments in American art."

Numerous railroads such as the Pennsylvania railroad, Atchison, Topeka and Santa Fe, Chicago, Rock Island and Pacific, with a total of 90,000 miles of track, are using the water cement ratio method and other modern methods in designing concrete railroad structures. Concrete is used extensively by railroads in building bridges, tunnels, track slabs, etc.

Good Roads Bring Increase in Newspaper Circulation

GOOD roads have brought the country nearer the city. A farmer living twenty miles out in the country jumps in the family car and in 30 or 40 minutes he will be at the counter of some trading place. That is, if the roads are good.

But this is not the only way in which the country is nearer the city. Where good roads have been built the farmer is kept in touch with the world at large, not alone through the radio, but through his daily newspaper.

Motor Deliveries Profitable

The Indianapolis News has found motor deliveries to rural districts highly profitable through the increased circulation and through the higher advertising rates the advertisers were consequently willing to pay, according to John M. Schmid, circulation manager. Mr. Schmid declares that the last subscriber on a 40 mile rural route receives his newspaper at practically the same time the last paper is delivered in the residential district of Indianapolis.

Wherever possible the 60 routes of the Indianapolis News are confined to paved roads in order to give an economical year round service, according to Mr. Schmid.

Mr. Schmid has this to say in regard to the service which has been in operation since March, 1923: "Advertisers find favor in the plan as it tends to increase the radius of their trade. And the paved highways, most of which are concrete, make it convenient for customers from many miles around to get into the city quickly at any time."

Make 54-Mile Trip in Two Hours

The citizens of Greeley, Colo., a city 54 miles from Denver, receive their afternoon Denver newspaper at the same time it is placed in the hands of subscribers in the Denver residential section. This feat is accomplished daily by motor buses which make the trip in two hours over concrete roads.

The advantages of intensive rural circulation are: getting the paper quickly into the hands of the subscriber; serving people that otherwise could not be reached; increasing the circulation; and the giving of better service to the advertiser through this increased circulation.

But it must be remembered that an intensive rural delivery service is chiefly dependent on paved highways—highways that give year round service.

Build Automobiles Faster Than Roads

WITH motor vehicle registrations for the United States showing a gain of nearly 14 per cent in 1925 over the previous year, it is noted that paved highway building remained practically the same in both years.

If the 20,000,000 or more trucks and touring cars now registered were to be placed on both sides of the 39,659 miles of concrete rural highways there would be scarcely room for these cars to park comfortably.

About $51,750,000 is saved annually in Pennsylvania in automobile operating costs as the result of the construction of hard-surfaced roads, according to William H. Connell, an executive of the Pennsylvania Highway Commission. This saving indicates that unimproved roads are far more expensive than modern pavements.

MOTOR VEHICLE REGISTRATIONS FOR 1924 AND 1925

(These figures were taken from MoToR magazine with estimates made for December in all cases.)

State	1924	1925	Per Cent Gain 1925 over 1924
Alabama	157,262	194,580	23.7
Arizona	57,828	68,597	18.9
Arkansas	141,983	185,503	30.6
California	1,321,480	1,443,985	9.3
Colorado	213,247	238,132	11.7
Connecticut	214,318	253,221	18.1
Delaware	35,136	39,879	13.5
Dist. of Columbia	91,726	94,639	3.1
Florida	194,196	291,400	50.1
Georgia	209,300	247,906	18.4
Idaho	69,225	81,493	17.7
Illinois	1,123,724	1,266,791	12.7
Indiana	650,219	719,380	10.6
Iowa	620,906	662,745	6.7
Kansas	410,891	456,864	11.2
Kentucky	231,784	260,111	12.2
Louisiana	178,000	208,000	16.8
Maine	127,178	138,606	9.0
Maryland	195,581	242,637	24.1
Massachusetts	672,315	764,338	13.6
Michigan	868,787	992,826	14.3
Minnesota	502,987	569,531	13.2
Mississippi	134,547	176,085	30.9
Missouri	544,635	604,300	10.9
Montana	79,695	95,731	20.1
Nebraska	308,713	336,660	9.0
Nevada	18,387	21,377	16.3
New Hampshire	71,929	81,409	13.0
New Jersey	504,190	579,448	14.9
New Mexico	41,750	48,559	16.3
New York	1,375,735	1,579,031	14.8
North Carolina	305,756	364,177	19.1
North Dakota	117,061	145,530	24.3
Ohio	1,244,000	1,400,000	12.5
Oklahoma	342,982	458,000	33.6
Oregon	192,629	215,826	12.0
Pennsylvania	1,228,586	1,356,919	10.4
Rhode Island	90,652	104,648	15.4
South Carolina	163,382	170,673	4.2
South Dakota	142,280	167,291	17.6
Tennessee	204,680	248,021	21.2
Texas	834,040	977,572	17.2
Utah	79,233	90,313	13.9
Vermont	61,179	69,481	13.6
Virginia	261,643	298,870	14.3
Washington	294,812	341,713	15.9
West Virginia	190,134	213,762	12.4
Wisconsin	525,221	592,450	10.9
Wyoming	43,639	47,650	9.2
Total	17,726,507	20,204,260	Average 13.9

Build Pavements Thicker at the Edge

HEAVILY loaded army trucks equipped with solid rubber tires driven over 63 sections of various types of concrete, brick and asphalt paving, brought out the almost revolutionary fact that pavements should be thicker at the edge than in the center. The results of these tests conducted on the two-mile Bates Experimental Road near Springfield, Ill., in 1921-22 were so convincing that at present more than 30 states are building concrete pavements of a thicker-at-the-edge design.

During the first days of pavement building pavements were built thicker in the center with the belief that more traffic used this portion of the roadway. However, the growth of automobile traffic has changed this one-horse chaise method of travel. Modern country highways are now two and sometimes four traffic lanes wide, and heavy trucks commonly run along the edges of the pavement. Since the subgrade offers least support to the pavement along its sides when the soil is wet and the concrete slab itself was thinnest there on old-style pavements, it is not surprising that breaks have sometimes occurred at the corners of the slabs on such pavements.

Study Causes of Failures

In conducting the tests on the experimental road the trucks were first run over the road beginning with the bare chassis and gradually increasing the loads carried until they exceeded the legal limit of eight tons on the rear axle by nearly two-thirds. This traffic was continued at various speeds and under various conditions, while close observations were made of the sections which failed.

It was further learned that some reinforcing was needed to give the edges still more strength to resist the tremendous pounding of heavy trucks.

Of the total of sixty-three sections, twenty-two were of brick, seventeen asphalt and twenty-four concrete. When the tests were finished it was found that one brick section ($4\frac{1}{2}$ per cent), three asphalt ($17\frac{2}{3}$ per cent), and ten concrete sections ($41\frac{2}{3}$ per cent) had come through without a failure.

Experience and other experiments have borne out the results of the Bates test road.

Federal Aid in Road Building

DURING the ten years in which the Federal Aid Road Act has been in effect, the United States government has assisted the 48 states in building 63,000 miles of roadway. Through the medium of Federal Aid this country now is progressing on the best road system in the world.

Under the Federal Aid system, it is required that the important roads of each state link up with the important highways of the adjoining states. In this way, the United States has improved highways connecting all states which in time of war would constitute an invaluable military system.

In order that Federal Aid be distributed as widely and fairly as possible, not more than three-sevenths of the roads are to be primary highways of interstate importance. The remaining four-sevenths are to be secondary roads of inter-county importance. Under Federal Aid provisions the national government does not pay more than half of the cost of the road improvements, except in states with public lands.

FEDERAL AID PROJECTS COMPLETED AND UNDER CONSTRUCTION TO DECEMBER 31, 1925

(Compiled from Statistics of
THE BUREAU OF PUBLIC ROADS)

TYPE	Total Cost	% of Total Cost	Mileage	% of Total Mileage
Portland Cement Concrete	$532,550,745.79	43.4	13,498.8	21.4
Brick	34,423,205.63	2.8	765.8	1.2
Bituminous Concrete	58,313,434.34	4.8	1,607.8	2.6
Bituminous Macadam	105,953,317.02	8.6	3,585.3	5.7
Waterbound Macadam	25,355,928.61	2.1	1,278.8	2.0
Gravel	255,138,597.95	20.8	23,356.2	37.1
Sand-Clay	40,714,129.35	3.3	5,382.3	8.6
Graded and Drained	119,999,351.94	9.8	13,370.5	21.2
Bridges	54,584,143.34	4.4	148.5	0.2
TOTALS	$1,227,032,853.97	100.0	62,994.0	100.0

Concrete Streets Increase

THE small city is holding up its end in pavement construction, according to an analysis of concrete paving made by the Portland Cement Association. Nearly one-fifth of the concrete pavement contracts awarded last year were let in cities of 2,500 population or less and more than a fourth were awarded in cities of between 2,500 and 10,000 citizens.

The survey indicates that pavement construction is normally distributed, taking into consideration that nearly 90 per cent of the city dwellers live in

Real estate activities follow the construction of permanent and attractive concrete pavements.

centers of 10,000 population or less. It is to be expected that most paving is in the larger cities where traffic is greater. Fifty-six percent of the 1925 concrete paving awards were in cities of 10,000 or more people. A fifth of the contracts were awarded in the 81 cities of 100,000 population or more.

For a time concrete rural highway paving attracted much more attention than city paving. However, since concrete has proved itself an ideal paving material for motor traffic, cities have widely adopted it and the street yardage is now being increased 2,000 miles or more yearly. Concrete is not only easy to install but its maintenance cost is very low. Another notable feature of concrete paving is its low traction resistance. Concrete is also skid-proof.

Concrete pavement awards last year totalled 2,026 miles. Following are the yardages of concrete paving contracted for by the 30 largest American cities during 1925:

5 CITIES WITH POPULATION OVER 1,000,000

CITIES	During 1925	Total to Jan. 1, 1926
Chicago	541,313	1,209,608
Detroit	16,904	622,991
Los Angeles	2,257,147	7,763,589
New York	192,285	793,846
Philadelphia	75,631	223,193
	3,083,280	10,613,227

8 CITIES WITH POPULATION BETWEEN 500,000 and 1,000,000

Baltimore	82,465	893,280
Boston	10,675	114,273
Buffalo	29,640	90,750
Cleveland	23,899	308,736
Milwaukee	343,580	990,889
Pittsburgh	3,737	81,041
San Francisco	12,692	173,232
St. Louis	118,483	270,689
	625,171	2,922,890

17 CITIES WITH POPULATION BETWEEN 250,000 and 500,000

Cincinnati	101,438	314,289
Columbus, O.,	4,779	10,949
Denver	28,140	138,201
Indianapolis	78,837	436,614
Jersey City	......	....
Kansas City, Mo.,	343,533	3,082,769
Louisville	......	7,770
Minneapolis	13,323	337,981
Newark, N. J.	17,900	67,280
New Orleans	18,951	181,153
Oakland, Cal.	.....	70,258
Portland, Oreg.	222,798	1,426,438
Providence, R. I.,	4,000	4,000
Rochester, N. Y.	6,000	26,290
Seattle	768,873	2,970,731
Toledo	51,651	664,211
Washington, D. C.	257,205	871,019
	1,917,428	10,609,953

A Mile of Concrete Road

IN building a single mile of concrete road more than 4,000 tons of materials are necessary, exclusive of water. In other words, two big train loads of cement, sand and stone must be delivered on the job.

To some taxpayers, such a mass of materials may appear to represent a cost that would make a concrete rural pavement a luxury rather than an investment. However, anyone who has studied highway costs knows that where traffic is at all heavy the ordinary dirt or gravel road is much more expensive than a pavement.

Pavements Save Money

For instance, thorough study at the Iowa State College Experiment Station has revealed that in driving an automobile over a concrete road rather than a dirt road an average of 2.6 cents per car-mile is saved, and proportional savings are made with trucks.

If 500 motor vehicles pass over a concrete highway daily the yearly saving for one mile alone will be $3,600. It has been shown that the total cost of transportation on a concrete road carrying only 500 motor vehicles a day—including all operating costs of the cars and interest, depreciation, and maintenance of the highway—is about $3,600 per mile less than for dirt roads and $2,370 less than for gravel. Consequently the dirt or gravel road is the more expensive yet by no stretch of the imagination can such a road be called luxurious.

In converting a gravel or dirt road into an 18-foot concrete pavement it is necessary to place 2,000 cubic yards of concrete for each mile of 18-foot slab seven inches thick. To make this concrete 3,400 barrels of portland cement or 17 car loads, are needed. Thirty-two cars of sand, or 1,100 cubic yards, and 46 cars of crushed stone, or 1,600 cubic yards, are mixed with this cement. For mixing and curing this concrete some 300,000 gallons of water are required.

Coal and Dynamite Also Used

Yet the building of a concrete road really begins long before actual work is started on the roadbed. Four hundred pounds of dynamite are needed to blast rock in the quarry to make enough portland cement for a mile of road. To burn the raw cement materials, 340 tons of coal, or its equivalent, are used. In order to regulate the setting time of the cement when used in concrete about 19 tons of gypsum are required. Although cement is generally measured by the

Through modern methods concrete roads are being built two or three times as fast today as they were 15 years ago.

barrel it is usually delivered in sacks, each of which holds a cubic foot. In order to supply cement for a mile of concrete road about 13,600 sacks are needed.

To mold this mass of material into a concrete highway would seem to require almost superhuman effort. Yet the road builder, with his modern methods and equipment, is able quickly and efficiently to create a smooth-riding and lasting pavement.

Ancient Toll Roads Cost More Than Best Roads of Today

WHEN Mr. Silas Wickes went to market only a half century or so ago, it cost him more money to travel over the "rough and ready" roads of his time than it costs Hiram Acres today to travel over the best road that can be built.

Every two or three miles Silas was obliged to dig down into his home-made jeans and pay the toll man at the rate of three cents per mile, that is, if Silas were driving a "chariot, coach, stage, wagon, phaeton or chaise, with two horses and four wheels."

If Silas were riding a horse and driving 20 head of cattle it would cost him a total of five cents for each mile. So in going a distance of 10 miles with his herd of cattle he would be forced to pay 50 cents—a small fortune for almost any boy in those days. Imagine what proportion of Silas' income went to pay for traveling over a trail of ruts!

Poor Roads Come High

The old toll road was never a matter of civic or rural pride. In fact, these ancient highways were so bad that those who used them accepted them with a grim forbearance. They were really nothing more than rights-of-way dotted with mudholes and sunken bridges. Yet even with the exorbitant rates charged for the use of these roads, the owners claimed that the returns did not warrant keeping them in good repair.

So the motorist of the present day has much to be thankful for, since it costs him about half as much per mile for concrete roads as it cost Silas and his fellowmen for roads of the worst sort. Three cents per mile was the cost for traveling with an ordinary vehicle on the toll road. Today if an average of only 500 vehicles pass over a mile of concrete road daily, the cost is only 1.6 cents per mile.

Concrete Maintenance is Low

For example, take concrete pavement costing about $30,000 per mile. At six per cent the yearly interest charge on the cost is $1,800. The sum to be put aside each year to replace the pavement at the end of 20 years if needed, is $1010. Maintenance may be estimated at $80 a year. The total yearly cost of the mile of pavement is then $2890, much less than the cost of even a good graveled road where traffic is at all heavy.

Even where traffic is light, concrete pavements usually cost less than gravel roads. According to studies made at Iowa State College a concrete pavement with a daily traffic of 250 vehicles costs $630 less per mile each year than gravel.

So today when Hiram Acres heads the nose of his car towards town he is not worried by toll gates; he does not anticipate being pulled out of mudholes by a pair of mules or a windlass. His sense of satisfaction and comfort is so great that he does not reflect at all upon the low cost of the smooth pavement flying up to meet him.

Salesmen Travel Cheaper by Automobile

IN four years the operating costs of automobiles have been reduced more than one-third chiefly because of improved roads, according to figures supplied in a report of the Dartnell Corporation, a service organization for sales executives.

In 1920 it cost from 10 to 20 per cent more to travel by automobile than by train, states the report which was compiled through the assistance of 194 firms using automobiles for sales work. In 1922 it was estimated that the operating costs of cars had been reduced to about the same as the cost for train travel when all factors were figured in, ten cents per mile.

Good Roads Lower Travel Costs

However, in 1924 the operating cost of the salesman's car had dropped to six cents a mile. Considering that each salesman's automobile travels 10,000 miles per year, a conservative figure, the saving over operating costs in 1922 amounted to the astounding figure of $2,717,200 for the 6,793 cars of these 194 firms alone.

The Dartnell Corporation gives this as the reason for lower operating costs: "The extended development of good concrete roads, and the better roads program under way for the year, are changing the whole complexion of the problem of operating salesmen with automobiles. We have it on authority that improved roads, during the last two years, have cut down gasoline mileage and tire costs almost one-half in a number of states."

Another important development noted in the report is the increasing tendency for firms to operate their automobile sales service the year round. Of 187 companies, 163 are enabled to use their automobiles for the entire twelve months because of favorable road conditions in their territories.

Concrete Is Skid-Proof

SINCE concrete pavements are hard and even, it might seem to follow that such pavements would be slippery, especially in wet weather. However, this is not the case, as motorists are well aware, for concrete is practically skid-proof.

The skid-proof quality of concrete pavements is best demonstrated by its use on steep grades. Horses and motors have little trouble pulling loads on concrete-paved hills.

The following representative cities have concrete streets on very steep grades of the percentages shown:

	Per Cent
Los Angeles, Calif.	29
Bluefield, W. Va.	28
Mount Hope, W. Va.	27
Altoona, Penn.	27
San Francisco, Calif.	26½
Seattle, Wash.	26½
Savanna, Ill.	23
Appalachia, Va.	22
Patterson, N. J.	21
Hannibal, Mo.	19½
Birmingham, Ala.	19
Kansas City, Mo.	18
Little Falls, N. Y.	18
Duluth, Minn.	17½
Council Bluffs, Ia.	17
El Paso, Tex.	17

The portland cement industry ranks third in the size of investment per wage earner, according to the figures of the U. S. Census of Manufactures. The capital investment of the portland cement industry today is about $500,000,000. Turnover of capital is slow—about once in two years.

GASOLINE TAX AND AUTOMOBILE LICENSE FEE

In Each State During 1925

STATE	Gas Tax (Cents)	Gas Tax 500 Gallons	Motor Vehicle Fee on Dodge Touring Car	Cost of Fee Plus Gas Tax on 500 Gallons
Alabama	2	$10	$12.75	$22.75
Arizona	3	15	5.00	20.00
Arkansas	4	20	21.70	41.70
California	2	10	3.00	13.00
Colorado	2	10	4.00	14.00
Connecticut	2	10	17.04	27.04
Delaware	2	10	13.10	23.10
Dist. of Columbia	2	10	1.00	11.00
Florida	4	20	16.40	36.40
Georgia	4	20	11.85	31.85
Idaho	2	10	25.00	35.00
Illinois	0	—	8.00	8.00
Indiana	3	15	6.00	21.00
Iowa	2	10	17.20	27.20
Kansas	2	10	11.50	21.50
Kentucky	5	25	19.20	44.20
Louisiana	2	10	16.32	26.32
Maine	3	15	12.70	27.70
Maryland	2	10	7.68	17.68
Massachusetts	0	—	10.00	10.00
Michigan	2	10	14.85	24.85
Minnesota	2	10	21.12	31.12
Mississippi	3	15	13.20	28.20
Missouri	2	10	16.50	26.50
Montana	2	10	15.00	25.00
Nebraska	2	10	14.50	24.50
Nevada	4	20	9.90	29.90
New Hampshire	2	10	11.90	21.90
New Jersey	0	—	9.60	9.60
New Mexico	3	15	10.50	25.50
New York	0	—	13.50	13.50
North Carolina	4	20	12.50	32.50
North Dakota	1	5	15.80	20.80
Ohio	2	10	4.00	14.00
Oklahoma	3	15	18.00	33.00
Oregon	3	15	34.00	49.00
Pennsylvania	2	10	9.60	19.60
Rhode Island	1	5	14.20	19.20
South Carolina	5	25	15.00	40.00
South Dakota	3	15	17.00	32.00
Tennessee	3	15	17.52	32.52
Texas	1	5	17.70	22.70
Utah	3½	17.50	5.00	22.50
Vermont	2	10	22.95	32.95
Virginia	4½	22.50	14.40	36.90
Washington	2	10	17.20	27.20
West Virginia	3	15	17.20	32.20
Wisconsin	2	10	14.00	24.00
Wyoming	2½	12.50	12.00	24.50
			Average	25.62

This Detroit-Pontiac superhighway marks a new era in road building. When a similar strip of concrete pavement is completed for northbound traffic, the total paved width will be 88 feet.

Giving the Gasoline Horse a Better Road

WITH 20,000,000 more motor vehicles now on the nation's roadways than there were twenty years ago, it is no wonder that highway building has come to be one of the country's chief industries.

In considering that these 20,000,000 or so vehicles are motorized with something like 700,000,000 gasoline horses, it is not astounding that the antiquated road building methods of only a few years ago are being dumped into the discard along with divided seats and goggles.

The modern roadway is built for the motorist, the fellow who now does, or should, pay for the highways. In the good old days the rural road was built with the idea of furnishing some sort of trail from county to county. The early rural road received about the same care as a drainage ditch. Nowadays the highway is as carefully constructed as a skyscraper. The road is now designed with the motorist in mind.

One of the chief provisions now being made by highway commissions is that of wider rural roads, either through building them wider or through the broadening of existing pavements. For instance, unforeseen traffic increases have made it necessary to widen the Lincoln Highway west of Philadelphia. Ultimately a concrete road 40 feet wide will extend from Philadelphia to Harrisburg, a distance of 85 miles.

Build Road Edges Thicker

The other two dimensions of the road are being given equal attention by state highway departments. A few years ago it was customary in building a concrete pavement to thicken the pavement in the center. Findings from road tests have revealed that better service is obtained by thickening the outer few feet of the pavement since the strain is greater at the edge. Most

states now have adopted concrete road specifications calling for a thicker-at-the-edge design.

Length of pavement is another thing of great concern to the motorist. In 1909 there was but three miles of concrete rural highway in the entire United States. Today the concrete rural road mileage has almost reached the 40,000 mile mark. Yet this considerable mileage would scarcely provide comfortable parking place for the nation's automobiles.

The increased automobile traffic has forced the widening of the Boston Post Road until it now accommodates four lanes of traffic. Here the fourth lane is shown under construction.

Concrete Mileage Increases

However, the concrete mileage is increasing about 6,000 miles each year. During the current season an almost unbroken stretch of concrete roadway will be completed which will extend from a few miles north of Green Bay, Wis., through Chicago and on to Topeka, a distance of nearly 1,000 miles. This one highway is an indication of the rural road building of the future.

Aside from the improved physical characteristics of the modern road are other features which have been inaugurated by the road builders for the convenience of the public. Missouri and other states are doing their best to eliminate the detour by confining new highway building to as few of the important routes as possible.

Keep Motorist in Mind

Another plan adopted by many states where no good detours are available is the building of a concrete road half at a time, a method whereby traffic may continue throughout construction. For example, New Jersey built the 20-foot Shore Route in two ten-foot strips. During the construction of the first strip traffic passed over ten-foot gravel shoulders at either side of the pavement bed. Later when the first completed strip of pavement had cured properly it was opened to traffic along with one of the ten-foot shoulders, thus giving a 20-foot roadway.

Curves on the up-to-date highway are no longer dangerous. By widening the pavement and by super-elevating the outer pavement edge highway engineers have taken another big step in providing safety and comfort for the motorist. The plasticity of concrete makes such construction practicable.

The highway user is getting more and more for his money. W. H. Connell, president of the American Road Builders' Association, estimates that improved roads save American motorists $1,630,000,000 annually. Since the yearly road bill is about one billion dollars, better roads not only pay the entire road bill but they save $500,000,000 a year.

These 700,000,000 gasoline horses now loose on the highways will soon be increased to 1,000,000,000. It is the job of the highway builder to provide suitable roadways for them.

Concrete Pavement Upkeep Low

IN driving over ordinary dirt or gravel road, the motorist may not realize that the upkeep for this highway, if the traffic borne by it is at all heavy, runs into thousands of dollars each year for every single mile.

Many counties have found by actual experience that it is much cheaper to construct pavements which provide year around service.

Figures compiled by the Minnesota State Highway Commission show that the yearly cost of gravel roads on main routes is almost twice that of concrete roads. Depreciation, interest on investment, and the upkeep on the concrete trunk highway No. 3 cost Minnesota $1,678 per mile. The total cost per mile on trunk highway No. 1, a gravel road, was $3,101, a difference of $1,423 for each mile which properly should be listed as a loss.

In cities the matter of street maintenance is being given careful attention. Careful records kept by Beloit, Wisconsin, show that concrete city pavements cost far less than the other two types of pavement in use in that city.

Beloit expended a total of $3,665 in seven years on an average of 249,-900 square yards of a type of pavement other than concrete while an average of 105,937 square yards of concrete cost the city only $122.

"It isn't the first cost, it's the upkeep" is a familiar saying, and to no purchase does it apply with more force than to highways. The following figures were compiled in New York during a four-year period, and they show clearly what the various types of roadways cost from the standpoint of maintenance per mile per year:

Average Number of Vehicles per Day	Less than 500	500-1000	1000-2000	Over 2000
Maintenance Cost per Mile Per Year of Pavement only for:				
Concrete (first class)	$ 62	$ 54	$ 76	$149
Brick	165	99	109	279
Bituminous macadam (conc. base)	99	146	146	229
Bituminous macadam on macadam base	375	513	302	544
Bituminous macadam (penetration)	303	355	409	646
Waterbound macadam	551	652	692	881
Gravel	584	721	675	824

The simplicity and beauty of the Key bridge at Washington, D. C., illustrates the tendency in modern bridge building.

TOTAL MILEAGE OF ROADS
MILEAGE IN FEDERAL AID SYSTEM AND MILEAGE OF CONCRETE ROADS IN THE UNITED STATES

STATE	Total Highway System	Federal Aid System Mileage	Equivalent Miles Concrete Surface 18-Feet Wide: Built 1925	Total Jan. 1, 1926
Alabama	56,551	3,872,00	70	118.3
Arizona	21,400	1,498.00	1	434.3
Arkansas	71,960	5,007.03	28	230.1
California	70,000	4,467.60	161	3,626.9
Colorado	48,000	3,332.00	14	204.6
Connecticut	12,000	835.43	35	349.1
Delaware	3,800	335.43	63	418.2
District of Columbia	—	—	1	9.0
Florida	27,548	1,901.00	66	229.7
Georgia	80,892	5,557.90	65	428.8
Idaho	40,200	2,768.60	10	48.3
Illinois	96,771	5,002.22	853	4,957.5
Indiana	70,946	4,679.00	337	1,872.2
Iowa	109,113	7,231.00	64	600.4
Kansas	124,143	7,516.00	32	516.7
Kentucky	53,000	3,639.95	82	232.9
Louisiana	40,000	2,771.00	7	36.4
Maine	23,104	1,393.46	3	68.8
Maryland	14,810	1,417.48	120	1,086.2
Massachusetts	20,525	1,308.00	50	278.9
Michigan	75,000	4,768.00	425	2,467.2
Minnesota	103,050	6,849.60	94	614.2
Mississippi	53,000	3,329.00	39	250.9
Missouri	111,510	7,530.00	477	980.2
Montana	67,100	4,366.00	—	27.0
Nebraska	80,272	5,489.00	26	94.8
Nevada	22,000	1,434.00	7	38.4
New Hampshire	14,112	977.39	6	17.9
New Jersey	17,120	1,198.30	113	802.9
New Mexico	47,607	3,250.00	6	80.5
New York	81,873	5,012.00	615	3,409.2
North Carolina	60,000	3,790.30	329	1,170.7
North Dakota	106,202	6,154.00	—	7.4
Ohio	84,497	5,798.50	210	1,856.2
Oklahoma	112,698	5,573.00	188	563.3
Oregon	41,826	2,814.00	25	252.4
Pennsylvania	90,000	3,670.55	724	3,431.2
Rhode Island	2,368	234.13	14	66.2
South Carolina	52,318	3,150.00	56	209.2
South Dakota	115,390	5,666.00	—	1.4
Tennessee	65,204	3,180.20	75	204.6
Texas	182,816	10,932.00	71	560.3
Utah	24,057	1,588.00	2	241.1
Vermont	14,900	1,043.00	5	24.8
Virginia	53,338	3,075.50	91	705.9
Washington	42,428	2,907.90	81	1,110.7
West Virginia	31,629	1,918.50	68	637.2
Wisconsin	78,800	5,493.36	152	2,073.2
Wyoming	46,320	3,071.70	—	13.0
TOTALS	2,862,198	178,797.03	5,961	37,659.3

Missouri Invests in Paved Roads

ONLY a few years ago Missouri wasn't proud of her roads, in fact she didn't like to talk about them at all. They were almost impassable during the rainy seasons, and when the sun came out Missouri highways were so rough that the life of the average automobile was cut in half.

But today this is all changed. Missouri is hard at work at the big job of building a system of paved roads, a system that embraces the entire state.

In the early fall of 1921 the voters authorized a $60,000,000 bond issue to be financed with automobile registration fees. The program outlined called for the hard surfacing and maintenance of 7,640 miles of primary and secondary roads, about seven per cent of the entire Missouri rural road system.

Adds Gasoline Tax

During 1925 a gasoline tax of two cents per gallon was placed in effect which brought in a revenue of approximately $5,000,000. This sum added to the $8,000,000 obtained through the license fees makes a year's total of $13,000,000. Consequently it follows that Missouri will not only redeem the bond issue within a very few years but that she will also be able to enlarge her already extensive rural highway program.

In 1920 Missouri had but nine miles of concrete rural roads. At the close of 1925 she had more than 950 miles of concrete roads. A few years ago Missouri had a scant mileage of graveled roads. Today she has hundreds of miles of graveled highways in service, highways which will be paved as soon as the program permits. A hard surfaced roadway, all of which is concrete with the exception of seven miles, now reaches from St. Louis to Kansas City, a distance of 250 miles. So the Missouri method of highway financing, simple as it is, has proven itself more than a theory. Probably by no other means could this state have made such great road improvements within the short span of five years.

Increases Road Program

During the last three years Missouri has contracted for the building of $85,000,000 worth of roads and at present the state has $35,000,000 worth of highways under contract. This enlarged program is due to Federal Aid as well as the gasoline tax revenue.

The end of the pavement—mud ahead. Closing such gaps is essential to efficient car operation.

Missouri has a population of 3,500,000 people. Some of the other states with populations as large, and a few even larger, have not equalled Missouri's feat in highway building. Neither have many of these states formulated programs which appear as hope-

ful for the future, nor as easy for the taxpayers.

Missouri modeled her road finance system after that of Illinois. Illinois first floated a $60,000,000 bond issue to be financed solely by automobile registration fees. This issue was so successful that a few years later another issue for $100,000,000 was voted, likewise to be financed only with motor vehicle license money. Illinois has not found it necessary to establish a gasoline tax but Missouri, with a smaller population, has found it advisable to take this step. Illinois now has over 5,000 miles of concrete rural roads criss-crossing the state and is planning the rapid construction of 5,000 miles more.

Reduces Detours

Aside from finances the Missouri plan has other unique features. Road work is concentrated on as few highways as possible each year in order to lessen detours. Missouri primary highways purposely do not pass through many of the small towns for the reason that most traffic is through traffic. In the interest of better pavements, most of the grading is done some months before the pavement is laid in order that the subgrade will be packed down by traffic.

Some people view present highway building with something akin to alarm. However, good roads boosters are rapidly increasing for the economies of better highways are self-evident. No one will question that an automobile rides more smoothly and comfortably on paved roads. Hinging on this is the fact that automobiles cost less to run and last longer on pavements.

Where traffic is at all heavy, good roads not only cost the user nothing but save him money. Tests conducted by state highway departments and state colleges throughout the country prove conclusively that pleasure cars may be run at a saving of at least two cents a mile on concrete over gravel and that six cents per mile may be saved in the operation of a three-ton truck. This is a net saving of $20 per thousand miles for the pleasure car and $60 for each thousand miles for the truck. In Missouri the tax on 500 gallons of gasoline plus the average registration fee of the car totals about $22. The tax collected by the state is then paid for through lowered operating costs when the automobile has run only 1,100 miles.

Horses Pull Loads Easier on Concrete

THAT there is a wide difference in surface resistance of the various types of roadways is evidenced by late tests of the Horse Association of America. It is easily seen that more power is needed to pull a load on a dirt or gravel road but that an actual difference exists between the kinds of pavements is not so generally known.

The average results of the large number of tests conducted by the Horse Association in Chicago show that horses must exert a pull of 22 pounds per ton to keep a load moving on granite block; 18.8 pounds on brick; 47.3 pounds on asphalt; and only 14.7 pounds per ton on concrete.

These tests were made with ordinary equipment of 16 Chicago firms which use horses extensively for trucking.

Other tests conducted by the Horse Association show that it is four times harder to start a load on a dirt road than on concrete.

Motor Car and Road Costs

That concrete paving is most economical is shown by the tables given below, which were compiled by the Iowa State College Engineering Experiment Station after a long series of tests of various types of road surfacing. The first gives auto and truck operating costs:

TYPE OF SURFACE	Solid-Tire Trucks 10 Miles per hour — Cents per Ton Mile	Pneu.-Tire Trucks 15 Miles per hour — Cents per Ton Mile	Automobiles 25-35 Miles per hour — Cents per Vehicle Mile	Motorbuses 25 Miles per hour — Cents per Bus Mile
Average portland cement concrete	**8.00**	**8.30**	**10.00**	**24.00**
Average asphalt filled brick	**8.00**	**8.30**	**10.00**	**24.00**
Average asphaltic concrete	**8.00**	**8.30**	**10.00**	**24.00**
Average sheet asphalt	**8.10**	**8.30**	**10.00**	**24.00**
Bituminous macadam (well maintained)	**8.50**	**8.80**	**10.60**	**25.70**
Waterbound macadam (well maintained)	**8.70**	**8.95**	**11.10**	**26.00**
Ordinary gravel	**9.00**	**9.40**	**11.80**	**27.80**
Ordinary earth	**9.50**	**9.95**	**12.60**	**29.60**

Further investigation showed that for all roads used by as many as 250 vehicles a day, concrete paving is less costly than dirt. And even when the daily average is less than 100, the excess cost of concrete over dirt is but slight. Concrete was found to cost less than any other type, paved or unpaved, where the daily traffic amounted to 250 vehicles or more.

Must Consider Total Costs

By "cost" is meant the total annual cost of transportation in dollars per mile, assuming that 90 per cent of vehicles are automobiles, 5 per cent are pneumatic tired trucks and the remaining 5 per cent are solid tired trucks. This total cost is obtained by combining the cost of vehicle operation per ton-mile with the cost of the highway itself per ton-mile for the traffic passing over it. Results are given in the following table, which includes interest, depreciation, maintenance and operating costs for both vehicles and road surfaces:

Average Number of Vehicles per Day	100	250	500	750	1,000	1,500	2,500
Average Number of Tons per Day	150	375	745	1,120	1,500	2,250	3,700
Portland cement concrete	**5,760**	**11,840**	**21,980**	**32,130**	**42,310**	**58,360**	**103,070**
Brick	**6,190**	**12,230**	**22,390**	**32,530**	**42,690**	**62,980**	**103,430**
Asphaltic concrete	**6,080**	**12,140**	**22,360**	**32,490**	**42,680**	**62,900**	**103,480**
Sheet asphalt	**6,090**	**12,160**	**22,400**	**32,540**	**42,750**	**62,010**	**103,670**
Bituminous macadam	**6,810**	**13,270**	**24,100**	**34,920**	**47,730**	**69,180**	**109,970**
Waterbound macadam	**6,670**	**13,680**	**24,670**	**35,850**	**47,040**	**69,380**	**114,110**
Ordinary gravel	**5,350**	**12,470**	**24,350**	**36,240**	**48,140**	**71,920**	....
Ordinary earth	**5,320**	**12,850**	**25,580**	......	......	......	....

The investigation upon which the foregoing tables are based brought out that the sums paid by motorists in operating cars are the big items in highway transportation costs. By comparison, the expenditures of tax money by public officials are small. On main highways the car operating expense is from 20 to 60 times the cost of building and maintaining the road.

The Iowa tabulations show that an average of 1,000 vehicles daily over a gravel road represents an annual investment in road costs and automobile operation of $48,115 per mile. Similar transportation over a concrete pavement costs the public $39,625, a saving of $8,490. Where traffic amounts to 500 vehicles a day, concrete pavements save $4,950 per mile.

Tire Wear Less on Concrete

AUTOMOBILE tires wear out seventeen times faster on good macadam and fifty-six times faster on very poor macadam roads than on concrete pavements, according to tests conducted by Washington State college.

Touring cars were run over macadam and concrete road surfaces at different speeds. The amount of wear was determined by carefully weighing the tires before and after each run. It was found in running the automobiles over identical distances that the value of the rubber worn off on concrete was $0.98, on good macadam under Washington conditions, $16.72 and on poor macadam the loss was $56.72.

The cost of tires and gasoline for an average 4-cylinder car driven on a concrete road, as brought forth in the tests, is $12.80 for 1,000 miles. On a good macadam road it would be $35 for 1,000 miles. The reduced cost of driving on concrete is, according to these figures, 2.23 cents per car mile for tires and gasoline alone, reckoning the gasoline at 25 cents a gallon.

Estimates showed that in Washington the concrete roads cost $501 per mile a year more than macadam, considering investment, upkeep, interest, and salvage value at the end of its useful life. If it cost each car using a road 2.23 cents less to drive a mile on concrete than on macadam it will require a traffic of 22,480 cars a year, or only 62 cars a day over a road to earn this $501 differential. In other words, if a highway carries more than 62 cars a day the reduced costs in gasoline and tires alone make a concrete road actually cheaper for the user than a macadam pavement.

Stabilizing Advertising

A GLANCE through any progressive newspaper will show that there is an increasing tendency toward segregation of both news and advertising matter. In fact, many daily newspapers keep their income on an even keel by grouping advertisements in certain fields. For instance, the radio page may be run Monday, the house furnishings page Tuesday, the building page Wednesday and so on.

By so doing the attention of the reader is directed to solid pages of material that interests him. He is not required to search through the entire paper to find a desired item. Furthermore, advertising is stimulated, not so much through competition as through the enlarged market created by concentrated advertising.

The success of the building page has been so pronounced that editors have applied the same principles with excellent results to the promotion of other special pages such as fire prevention and good roads pages.

In order to conduct successful building pages and similar pages it is of course necessary to provide interesting features to accompany the advertising matter. For the building page the Portland Cement Association will furnish free of charge a series of house plan mats and a group of home improvement mats. This material along with local building news will provide a strong building page background.

Early in October of each year fire prevention week is observed throughout the country. Last year several hundred newspapers availed themselves of the information contained in the model

fire prevention page prepared by the Publications Bureau of the Association. Many newspapers also made use of the model good roads section prepared by this bureau for the observance of good roads week which is held yearly each January. Model pages will be supplied again this year, illustrating both appropriate advertising and news content.

So with very little trouble and expense, features may be added or improved that not only increase reader interest but stimulate advertising as well.

Newspapers Build Model Homes

THE building of model homes has been found by many newspaper publishers to be not only profitable to them but to be of real help to the community.

These newspapers have built model homes recently: The Topeka Daily Capital, the Boston Post, the Omaha Bee, the Syracuse Herald, the Lincoln Daily Journal, the Detroit News, the New York Herald-Tribune, the Albany Times-Union, the Minneapolis Journal, the Chicago Daily News, the Springfield, Ohio, Daily News, and the Joplin Globe. The Birmingham News and the Indianapolis News went a step farther, the former erecting four and the latter five model concrete homes.

Publishers have discovered that not only does the erection of a model home accelerate home building but that also steady advertising is appreciably stimulated.

After the promotion of the model home by the Joplin Globe, building permits in four months were increased nearly three and a half times in number and thirteen and a half times in value over the permits of the corresponding four months of the previous year.

In building a model home the desire is to obtain a beautiful and substantial house which at the same time is economical. Consequently concrete has been utilized extensively in such structures.

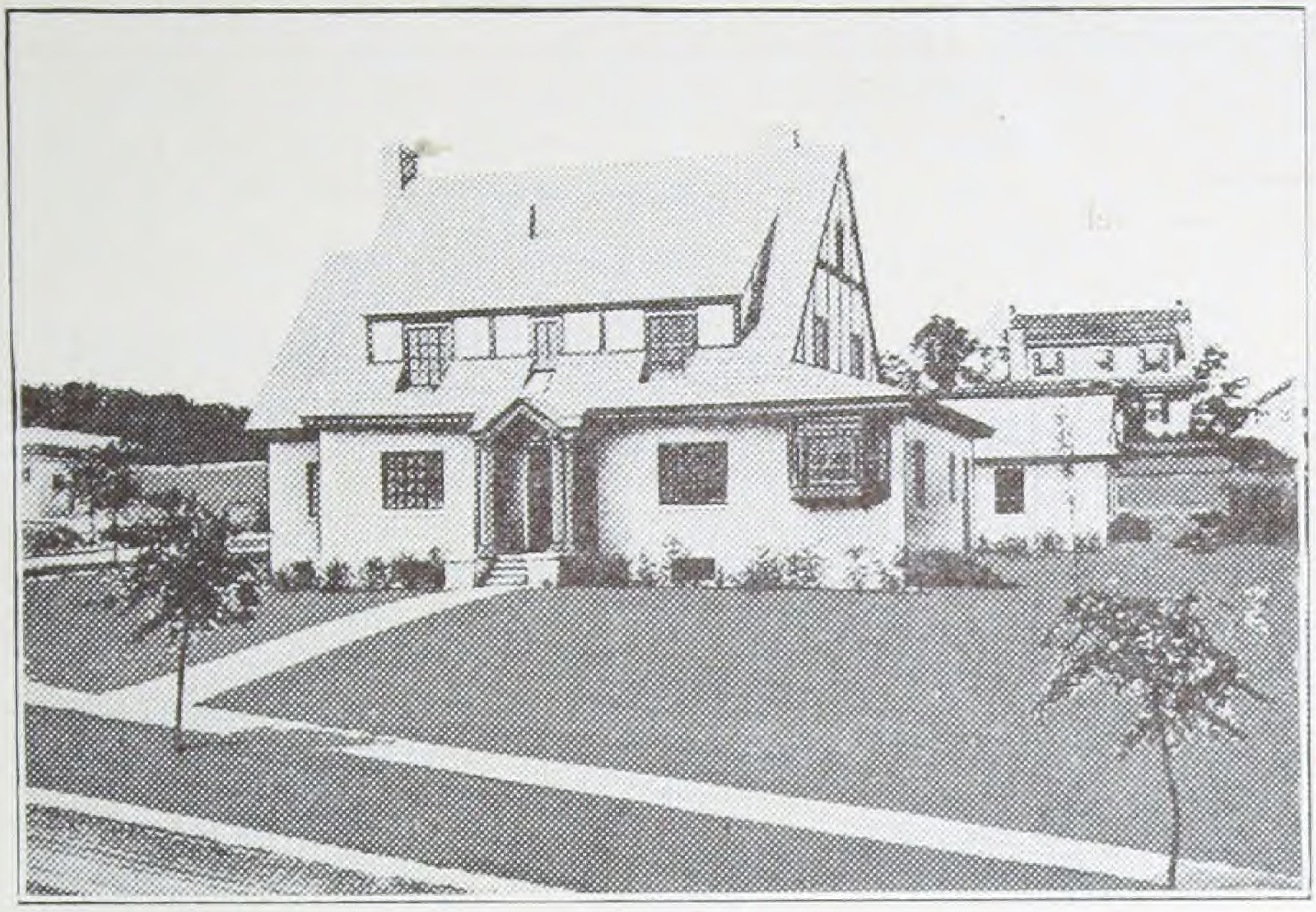
Ordinary concrete block or tile finished with portland cement stucco offer a wide range of attractive architectural effects, and that is the type usually chosen.

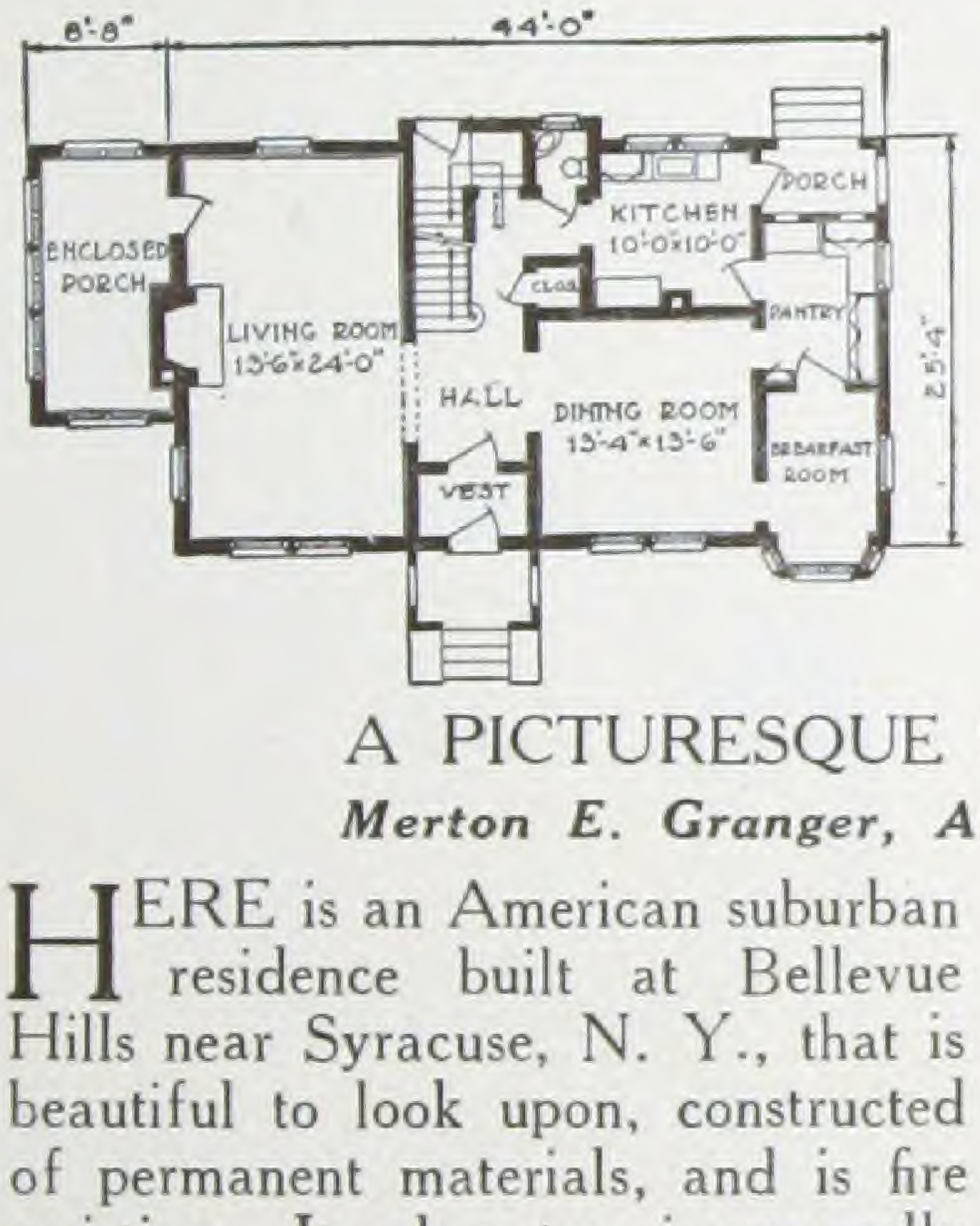
The newspaper need have no trouble in financing a model home. Oftentimes real estate or building firms are more than glad to handle the construction for the publicity value of such work and in the hope that other homes may be erected and sold, for one good house leads to another.

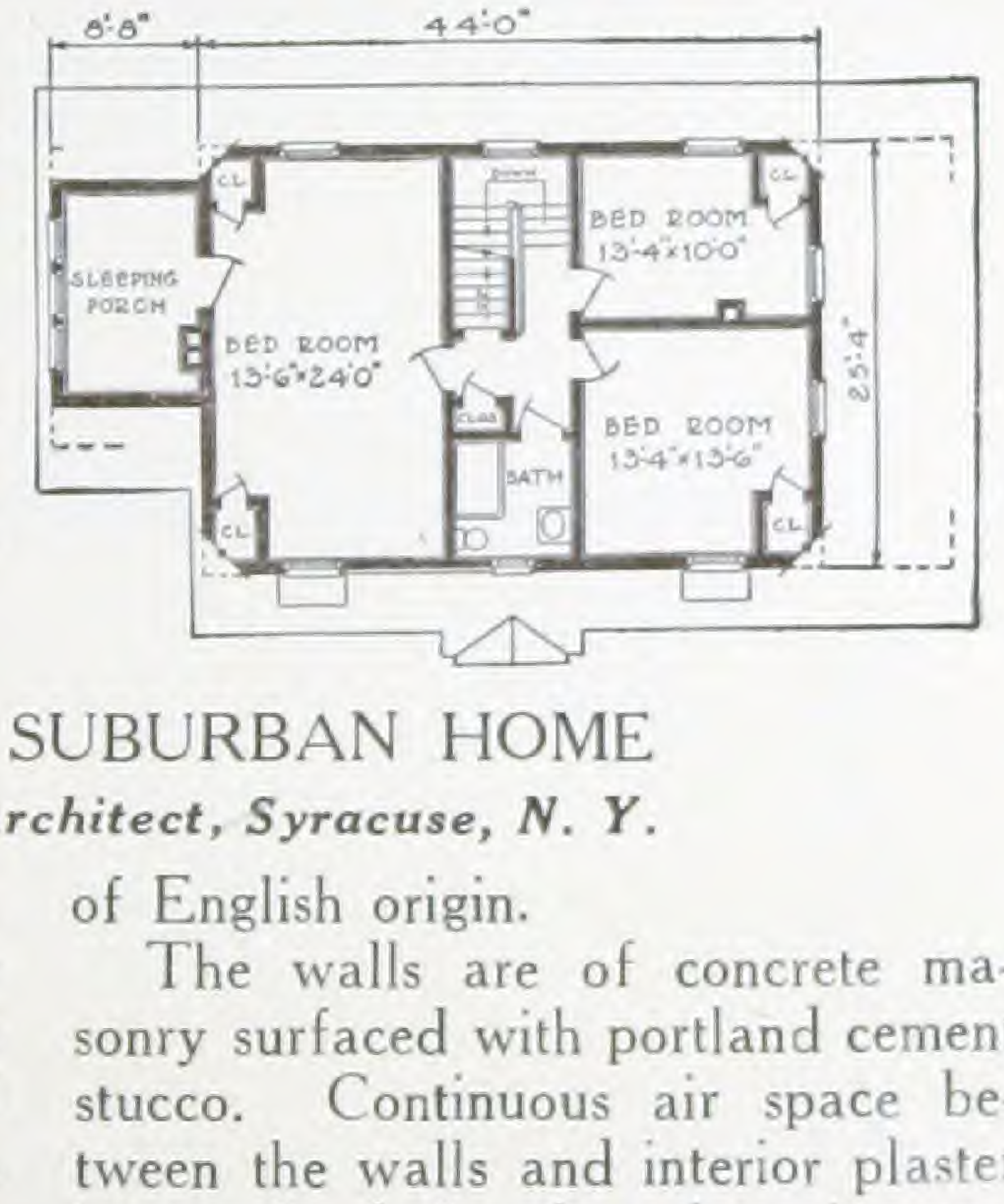
The building of this model home by the Topeka Daily Capital proved a profitable investment. After its erection home building greatly increased.

Another method of model home financing open to the publisher is that of securing a buyer for the house at the price advertised so liberally in the news articles before construction is started.

Beautiful—Permanent—Firesafe







A PICTURESQUE SUBURBAN HOME

Merton E. Granger, Architect, Syracuse, N. Y.

HERE is an American suburban residence built at Bellevue Hills near Syracuse, N. Y., that is beautiful to look upon, constructed of permanent materials, and is fire resistive. Its plan, too, is unusually well suited to the requirements of the average modern family.

The general contour of the house is reminiscent of the Dutch Colonial, although the sharp roof lines, half-timbered gables and small window openings of many panes are clearly of English origin.

The walls are of concrete masonry surfaced with portland cement stucco. Continuous air space between the walls and interior plaster insures insulation from heat in summer and cold in winter.

The floor plan is interesting. The large living room has a cozy fireplace and adjoins an enclosed porch or sun room. The dining room and cheery breakfast room are convenient to the well-equipped kitchen.

(Twenty house plans, similar to the above except that they are furnished in three-column mat form, will be mailed free to newspaper editors upon request. These newspaper screen half-tones give an excellent reproduction.)

Free Mat Service

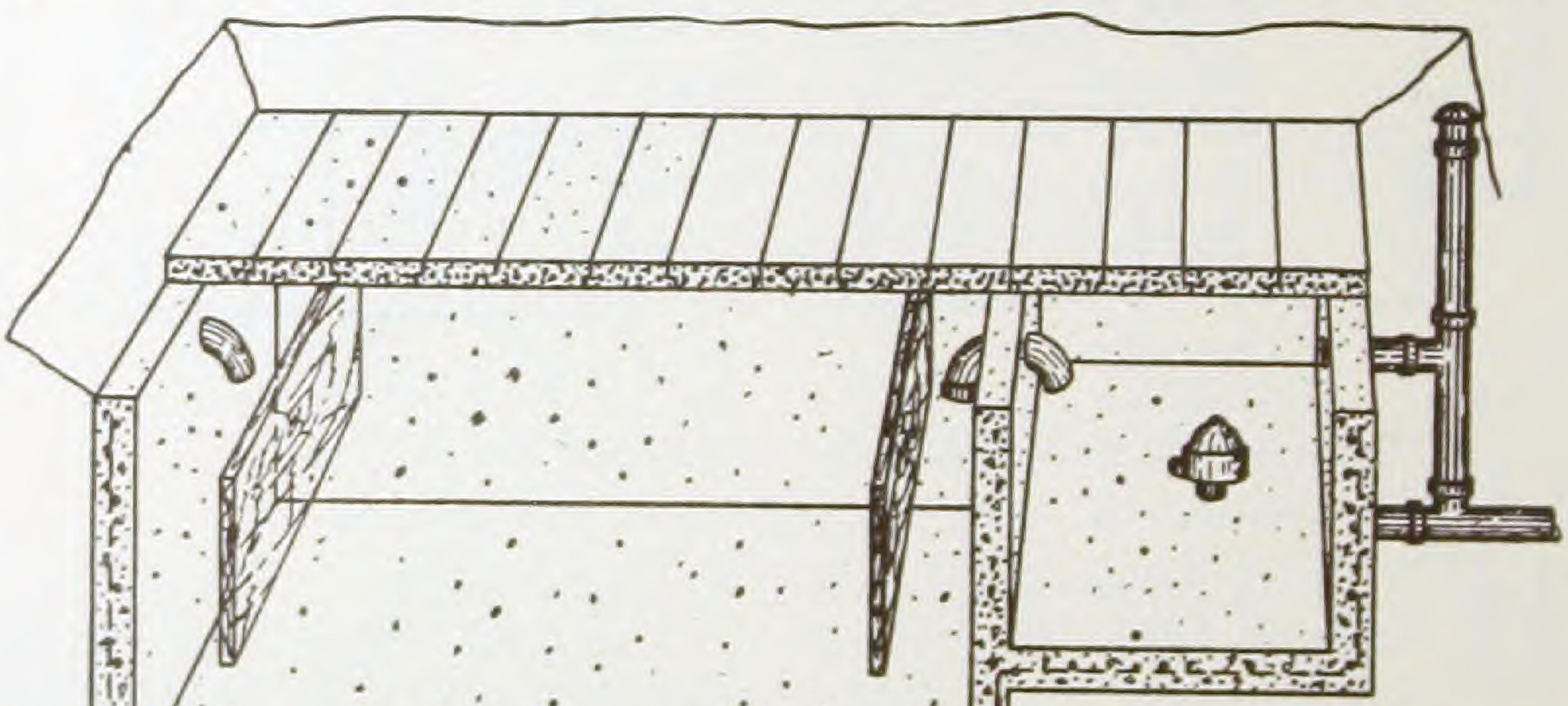
NEWSPAPERS with country and small city circulation will find the Portland Cement Association's free mat service most helpful. It offers a series of thirteen short, illustrated features on home improvements that put money in the pocket of the property owner. The specimen reproduced here is full width.

Every Farm Home Can Have Bathroom By Installing Efficient Septic Tank

What woman, who has enjoyed the comforts of modern plumbing in her home, would willingly go back to a house lacking such conveniences?

Not one in a hundred. Nor is it necessary, for any home, regardless of its location, can have the same sanitary conveniences formerly thought possible only in city homes.

Hot and cold running water and well-equipped bathrooms have become as much of a necessity in



Details of Construction for Septic Tank.

farm homes as they have in city homes. The reason has been the installation of a septic tank which safely and efficiently disposes of household wastes.

In such an installation, sho the drawing, the was work. to the tank wh erges into a tile ystem where any objectionable contents are destroyed. Certain other bacteria, which work best in contact with air, do this work. The liquid finally is discharged from the distributing system practically harmless.

When it is considered that more than 35 communicable diseases are directly traceable to untreated sewage, the need for such treatment is apparent.

Any local contractor can build a septic tank and guarantee its operation. The size of tanks vary with the size of the family, the smallest practical size being one for a family of five persons. Usually th are built of concret wh ent a permanent in mation to help nstall an efficient system. In addition, the editor of this newspaper will, upon request, give information as to where working drawings and complete information about concrete septic tanks may be obtained free of cost.

Location of Portland Cement Plants in the United States

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